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Temperature Correction Formulae for Adjusting Estimates of Emissions from Automobiles. Volume I

Vector Research, Inc.
Ann Arbor, MI

Prepared for

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TEMPERATURE CORRECTION FORMULAE FOR ADJUSTING ESTIMATES OF EMISSIONS FROM AUTOMOBILES

Robert L. Farrell

September 1979

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This report describes an analysis of the effects of temperature on the emissions of hydrocarbons, carbon monoxide, and oxides of nitrogen from automobiles. The analysis was conducted by Vector Research, Incorporated, (VRI) For the Environmental Protection Agency (EPA). The analysis was intended to provide formulae (referred to as correction formulae) which could be used to estimate the emissions of regulated pollutants at temperatures other than those used in the standard Federal Test Procedure (FTP).

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1.0 INTRODUCTION

This report describes an analysis of the effects of temperature on the emissions of hydrocarbons, carbon monoxide, and oxides of nitrogen from automobiles. The analysis was conducted by Vector Research, Incorporated, (VRI) under Purchase Order A-2098-NASX from the Environmental Protection Agency (EPA). The analysis was intended to provide formulae (referred to as correction formulae) which could be used to estimate the emissions of regulated pollutants at temperatures other than those used in the standard Federal Test Procedure (FTP).

The report is organized into four main sections and two appendices. The first three sections deal with the emissions of each of the three types under consideration; the fourth section summarizes the findings on all three emittants and describes how the resulting correction factor formulae may be combined with correction factors related to vehicle age and trip velocity to provide estimates of emissions under conditions other than the standard FTP test conditions in terms of temperature, vehicle age, and trip velocity. The appendices give brief descriptions of the analysis methods used in this study and the sources of the data analyzed.

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2.0 THE EFFECT OF TEMPERATURE ON HYDROCARBON EMISSIONS

Measurements of hydrocarbon emissions of more than 100 vehicles at various temperatures were available in the data sources described in appendix B. Because the desired form of the ultimate correction formulae for emissions concerned ratios of emissions at various temperatures, the first step in the analysis of the data was to take logarithms of all emissions data[1]. Since it was desired to separate the effects of temperature on emissions from any confounding effect related to the fact that vehicles had significantly different absolute emission levels, the second step in the preparation of the data for analysis was the reduction of the original emissions data, given in measured grams per mile of emissions for each of the three bags of the Federal Test Procedure, to temperature effect data. To do this, the mean log emissions of each vehicle at FTP temperature were estimated by the mean of the relevant measured emissions. This estimate of the FTP-temperature log emissions was then subtracted from each test measurement in the data for this vehicle to derive logarithmic temperature effect data for each test. Each such datum is essentially an estimate of the logarithm of the ratio of the emissions under the actual test conditions to those under FTP temperature conditions.

---

[1] In some of the data sets, mileage adjustments were made before this step, as described in appendix B.

2.1 THE EXISTENCE AND NATURE OF TEMPERATURE EFFECTS

Prior to fitting explicit temperature-dependency formulae, the data for each FTP bag was examined to determine whether temperature effects existed. To do this, the data was divided into three groups, one representing measurements at temperatures below the FTP range, one representing measurements in the FTP range, and one representing measurements at temperatures above the FTP temperature range. If no temperature effect was present, the distribution of the measured temperature effect in each of the low-temperature and high-temperature groups could reasonably be expected to be identical, and to have mean and median zero or very nearly zero. Exhibits 2.1 through 2.3 show the actual mean, standard deviation, minimum, quartiles, and maximum of the data in each of the two temperature groups for each of the three bags.

Inspection of the data indicates the presence of apparent temperature effects in all bags. To confirm this impression, formal statistical tests were applied to verify the presence of temperature effects in all three bags. Kolmogorov-Smirnov tests were used to test whether the high-temperature and low-temperature groups had statistically significantly different distributions. In bags one and three, the distributions were found to be significantly different (at better than the .001 level). In bag two, although the high-temperature and low-temperature groups could not be confirmed to have different distributions, both groups had means and medians which were significantly greater than zero, confirming the existence of temperature effects in all bags. As described in appendix A, the

EXHIBIT 2.1: BAG 1 HC TEMPERATURE EFFECTS

	LOW TEMP.	HIGH TEMP.
MEAN TEMPERATURE EFFECT	.79476	-.14428
STANDARD DEVIATION	.58818	.33888
MINIMUM TEMPERATURE EFFECT	-.94942	-.98774
FIRST QUARTILE	.39520	-.36291
MEDIAN	.69861	-.16697
THIRD QUARTILE	1.1444	.05658
MAXIMUM TEMPERATURE EFFECT	3.2364	.97728
NUMBER OF MEASUREMENTS	493	146

EXHIBIT 2.2: BAG 2 HC TEMPERATURE EFFECTS

	LOW TEMP.	HIGH TEMP.
MEAN TEMPERATURE EFFECT	.23725	.21971
STANDARD DEVIATION	.52257	.47489
MINIMUM TEMPERATURE EFFECT	-2.8371	-.80350
FIRST QUARTILE	-.02973	-.01791
MEDIAN	.18524	.11038
THIRD QUARTILE	.47473	.37071
MAXIMUM TEMPERATURE EFFECT	4.1967	1.9392
NUMBER OF MEASUREMENTS	493	146

EXHIBIT 2.3: BAG 3 HC TEMPERATURE EFFECTS

	LOW TEMP.	HIGH TEMP.
MEAN TEMPERATURE EFFECT	.00935	.26325
STANDARD DEVIATION	.48043	.38756
MINIMUM TEMPERATURE EFFECT	-3.1379	-.78989
FIRST QUARTILE	-.22510	-.05292
MEDIAN	.08511	.21165
THIRD QUARTILE	.23691	.46358
MAXIMUM TEMPERATURE EFFECT	2.8400	1.5182
NUMBER OF MEASUREMENTS	491	146

statistical tests used were non-parametric, so that no assumptions were required concerning the actual distribution of the measured temperature effects. On the basis of this analysis, it was found necessary to fit temperature effects equations to each of the three bags. From the data, it was expected that the equations would show increases in emissions at low temperatures for all three bags (with some possiblity that no effect would be found for bag three at low temperatures) and decreases in emissions at high temperatures for bag one, with increases at high temperatures for bags two and three.

2.2 EQUATIONS DESCRIBING TEMPERATURE DEPENDENCE

As described in appendix A, the data was found to show not only temperature effects, but also effects of model year and type of standards (California or 49-state Federal standards). As noted there, the data also showed an effect due to data source, but examination proved that the effects of model year and standards on temperature dependence remained even after allowance for the data source effect. Accordingly, separate fits were made for each model-year-standards combination in the data. As described in appendix A, the fits were made by least-squares methods to separate linear forms (in the temperature effects data - equivalent to exponential forms in actual emissions) for the low-temperature and high-temperature ranges. The fits generally showed the effects expected from the overall analysis, although a very few model-year-standards-bag combinations did not have the same pattern of effects as the majority (e.g., 1978, California-standards, bag-1, high-termperature emissions showed an increase, not a decrease, in emissions).

These fitted equations, together with the data to which they were fitted, are shown in semi-log scale plots and tabular form in exhibits 2.04 through 2.96. The plots also give the minimum and maximum temperatures at which measurements were actually available for the varous model-year-standards combinations. Data points for measurements below 0° are omitted from the plots and tables. The tables give values of the temperature effect equations at 5° intervals from 0° to 110°.

EXHIBIT 2.04: FITTED TEMPERATURE EFFECTS, HC BAG1

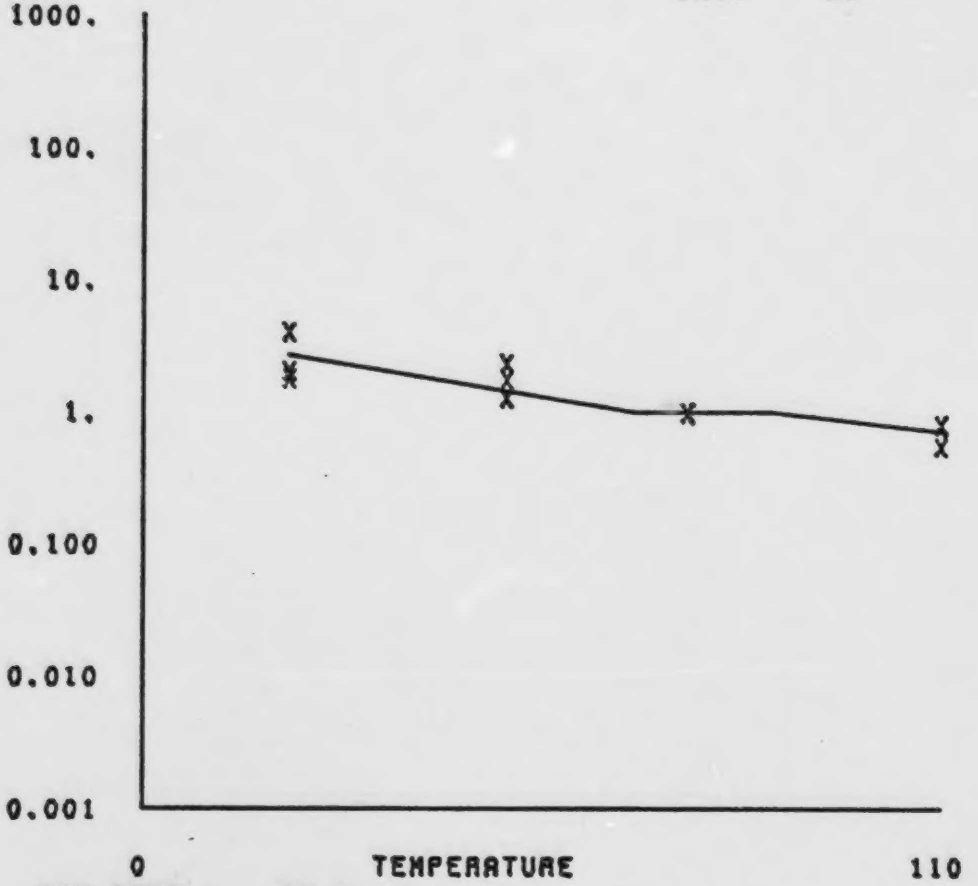
$$\frac{\text{EMISSIONS AT TEMPERATURE T}}{\text{EMISSIONS AT FTP TEMPERATURE}} = \begin{cases} \exp[c(T-67.5)] & \text{for T less than 67.5} \\ \exp[d(T-86.5)] & \text{for T greater than 86.5} \end{cases}$$

where exp is the exponential function and c and d are as tabled below.

MYR STDS	c	d
67FED	-.02062326	-.01438055
69FED	-.02446210	-.01255243
70FED	-.01063680	-.00791429
71FED	-.02400121	-.01213898
72FED	-.01950176	-.00865334
73FED	-.02188946	-.00659192
74FED	-.02204177	-.00579405
75CAL	-.01228174	-.09356240
75FED	-.01810858	-.00767091
76FED	-.02448914	NO DATA
77CAL	-.02718067	.00522853
77FED	-.02924139	-.02075194
78CAL	-.01564490	.00831953
78FED	-.01925075	-.01467854
80FED	-.02680335	.00483216

EXHIBIT 2.05

MYR=67: STDS=FED
BAG1 HC



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 6            STD ERROR(LOW TEMP)    33.94%
N(FTP TEMP) 3            STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 3            STD ERROR(HIGHTEMP)    17.87%

    EFFECT(LOW TEMP) = EXP(-0.020623  (TEMP-67.5))
    EFFECT(HIGHTEMP) = EXP(-0.014381  (TEMP-86.5))
```

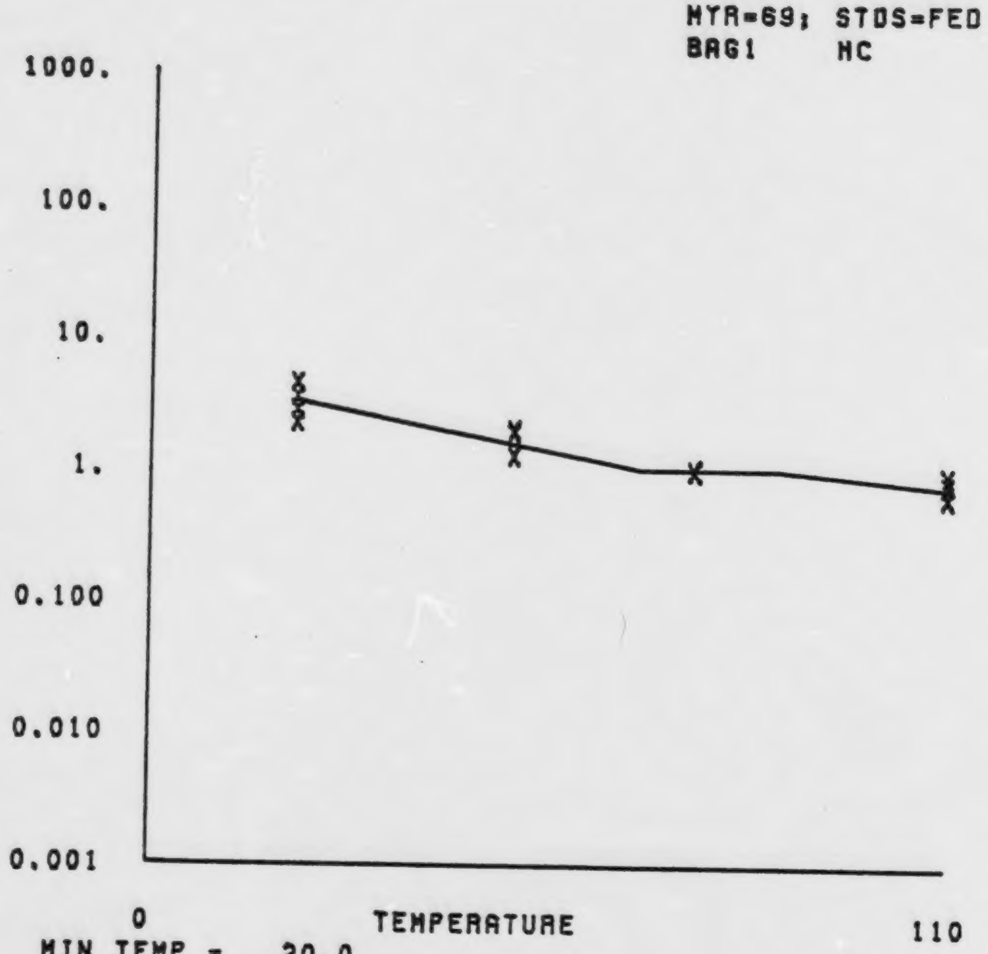
EXHIBIT 2.06

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC   67FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	4.0232
5.0	3.6290
10.0	3.2734
15.0	2.9527
20.0	2.6634
25.0	2.4024
30.0	2.1671
35.0	1.9547
40.0	1.7632
45.0	1.5905
50.0	1.4346
55.0	1.2941
60.0	1.1673
65.0	1.0529
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9509
95.0	0.8849
100.0	0.8235
105.0	0.7664
110.0	0.7132

EXHIBIT 2.07



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP)  8          STD ERROR(LOW TEMP)    23.78%
N(FTP TEMP)  4          STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP)  4          STD ERROR(HIGHTEMP)    16.11%

     EFFECT(LOW TEMP)  = EXP(-0.024462(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.012552(TEMP-86.5))
```

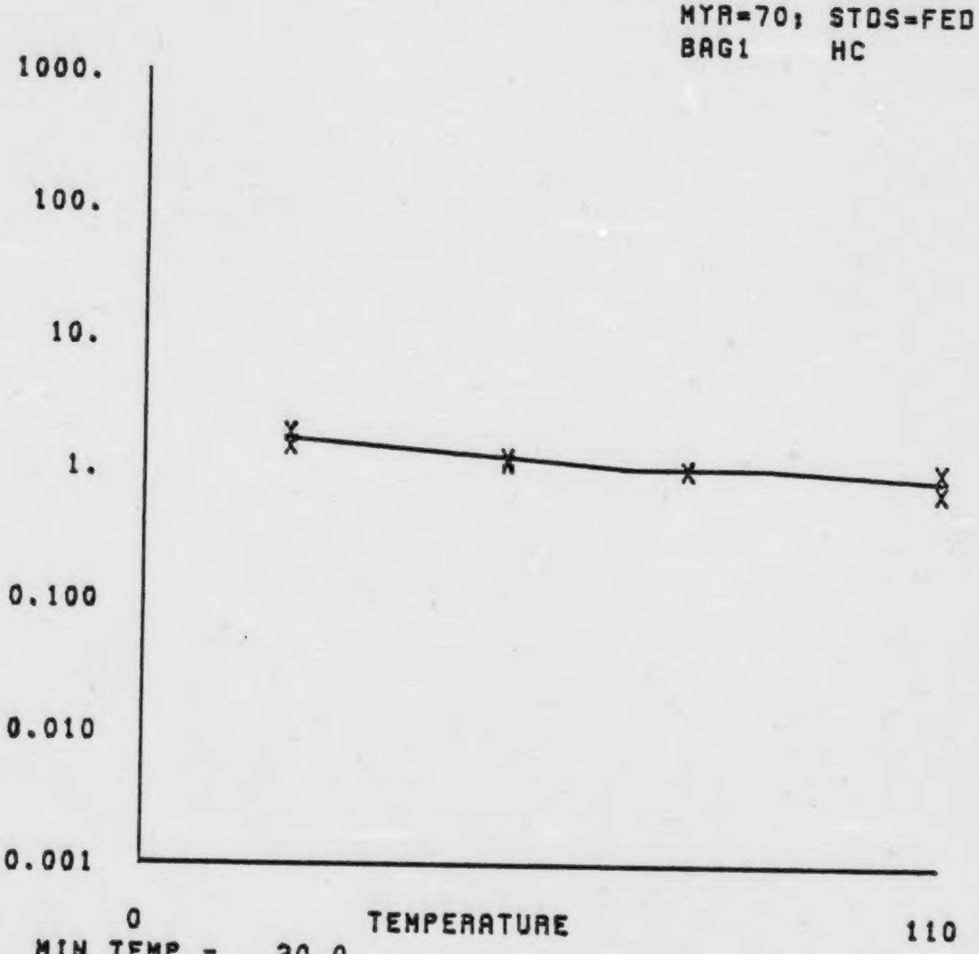
EXHIBIT 2.08

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC   69FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	5.2132
5.0	4.6130
10.0	4.0819
15.0	3.6120
20.0	3.1962
25.0	2.8282
30.0	2.5026
35.0	2.2145
40.0	1.9595
45.0	1.7339
50.0	1.5343
55.0	1.3577
60.0	1.2014
65.0	1.0631
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9570
95.0	0.8988
100.0	0.8441
105.0	0.7928
110.0	0.7445

EXHIBIT 2.09



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 4                STD ERROR(LOW TEMP)     9.16%
N(FTP TEMP) 2                STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 2                STD ERROR(HIGHTEMP)    17.69%

      EFFECT(LOW TEMP)  = EXP(-0.010637(TEMP-67.5))
      EFFECT(HIGHTEMP)  = EXP(-0.007914(TEMP-86.5))
```

EXHIBIT 2.10

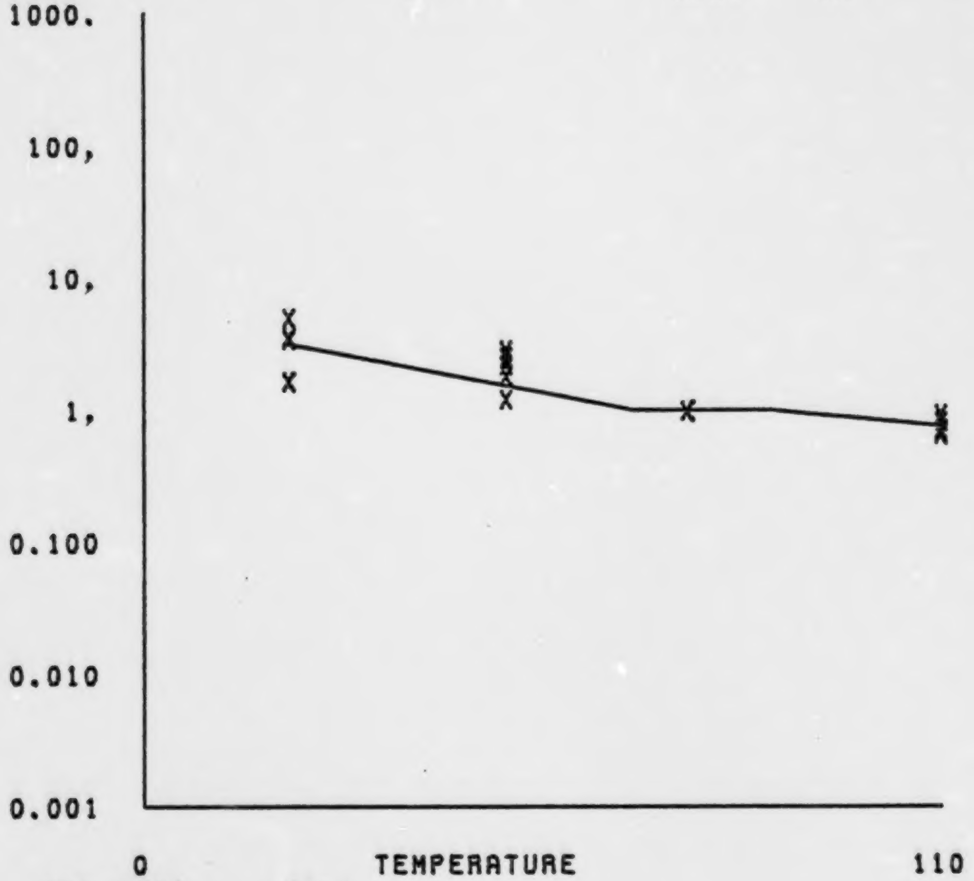
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC 70FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.0503
5.0	1.9441
10.0	1.8434
15.0	1.7479
20.0	1.6574
25.0	1.5716
30.0	1.4902
35.0	1.4130
40.0	1.3398
45.0	1.2704
50.0	1.2046
55.0	1.1422
60.0	1.0830
65.0	1.0269
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9727
95.0	0.9349
100.0	0.8987
105.0	0.8638
110.0	0.8303

EXHIBIT 2.11

MYR=71; STDS=FED
BAG1 HC



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 10            STD ERROR(LOW TEMP)    43.93%
N(FTP TEMP) 5             STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 5             STD ERROR(HIGHTEMP)    13.47%

     EFFECT(LOW TEMP)  = EXP(-0.024001(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.012139(TEMP-86.5))
```

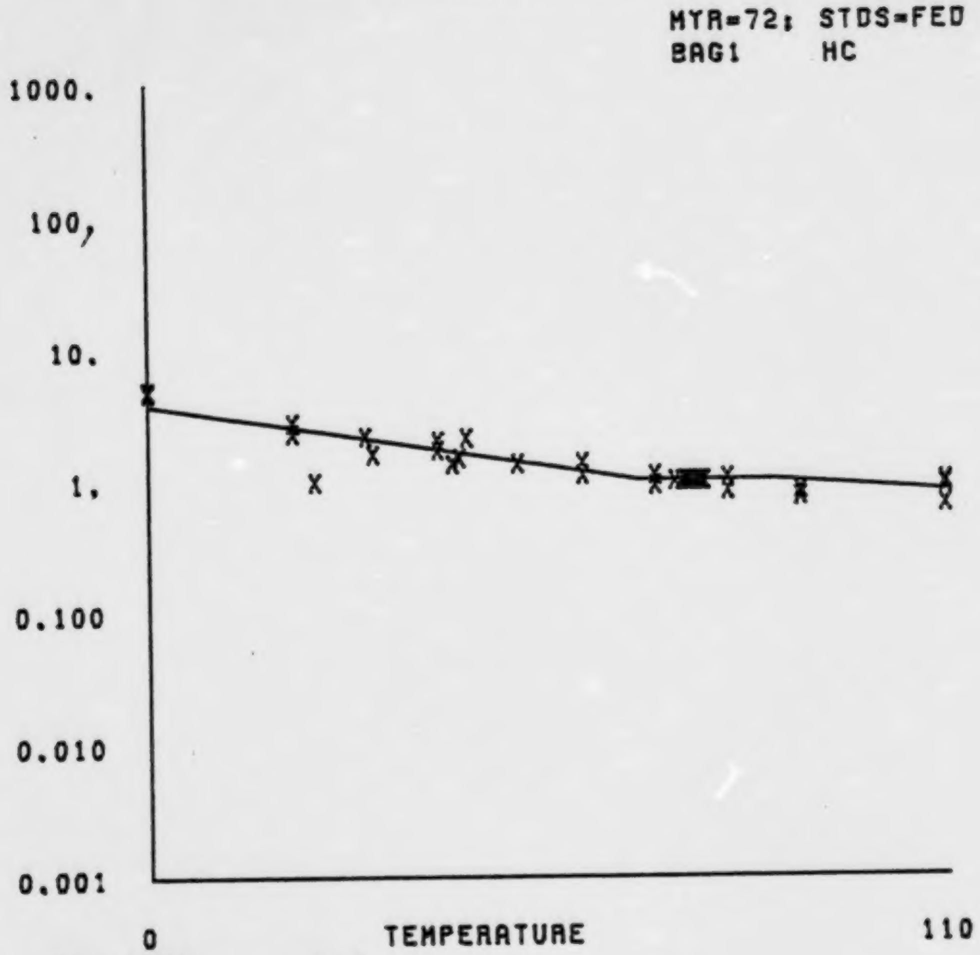
EXHIBIT 2.12

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC 71FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	5.0535
5.0	4.4820
10.0	3.9752
15.0	3.5256
20.0	3.1269
25.0	2.7733
30.0	2.4597
35.0	2.1816
40.0	1.9349
45.0	1.7161
50.0	1.5220
55.0	1.3499
60.0	1.1972
65.0	1.0618
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9584
95.0	0.9020
100.0	0.8488
105.0	0.7989
110.0	0.7518

EXHIBIT 2.13



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 18             STD ERROR(LOW TEMP)    27.20%
N(FTP TEMP) 12             STD ERROR(FTP TEMP)    12.69%
N(HIGHTEMP) 5              STD ERROR(HIGHTEMP)    18.70%

    EFFECT(LOW TEMP) = EXP(-0.019502(TEMP-67.5))
    EFFECT(HIGHTEMP) = EXP(-0.008653(TEMP-86.5))
```

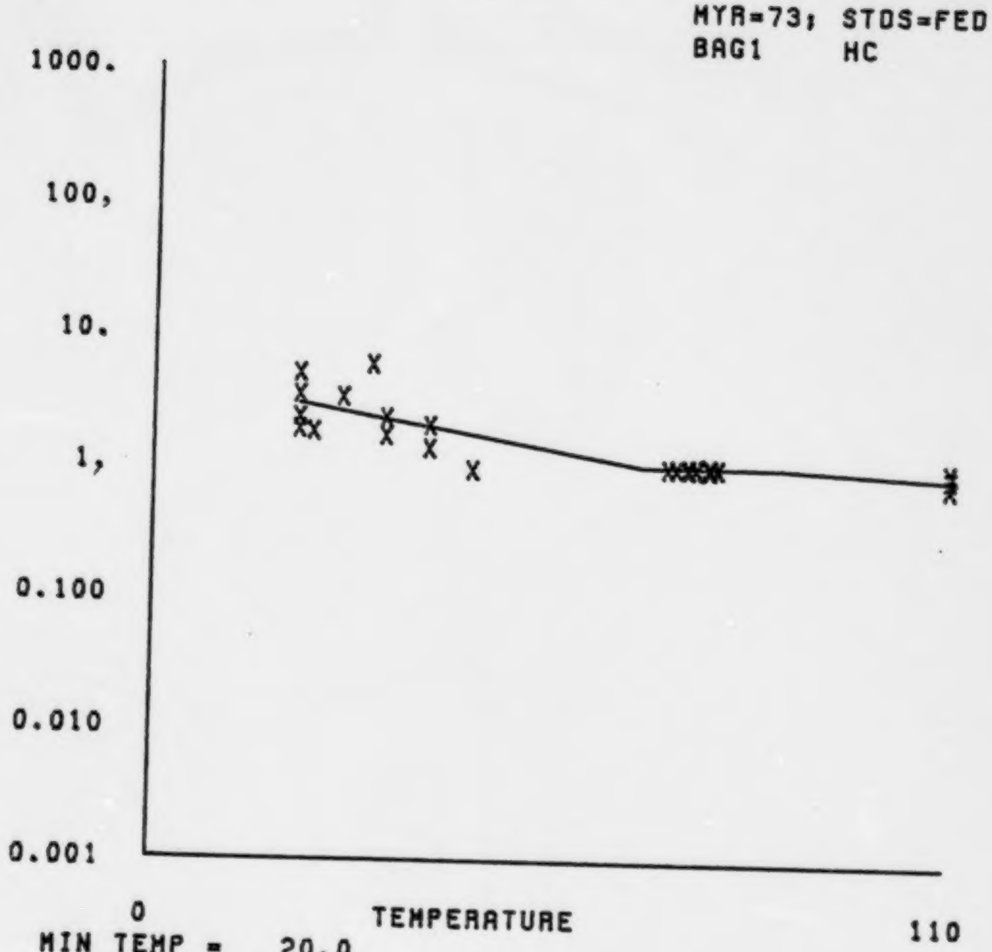
EXHIBIT 2.14

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC 72FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	3.7299
5.0	3.3833
10.0	3.0690
15.0	2.7839
20.0	2.5252
25.0	2.2906
30.0	2.0778
35.0	1.8848
40.0	1.7097
45.0	1.5508
50.0	1.4067
55.0	1.2761
60.0	1.1575
65.0	1.0500
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9702
95.0	0.9291
100.0	0.8897
105.0	0.8521
110.0	0.8160

EXHIBIT 2.15



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP)  12            STD ERROR(LOW TEMP)     43.05%
N(FTP TEMP)  12            STD ERROR(FTP TEMP)      0.0 %
N(HIGHTEMP)  4             STD ERROR(HIGHTEMP)     11.33%

     EFFECT(LOW TEMP)  = EXP(-0.021889(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.006592(TEMP-86.5))
```

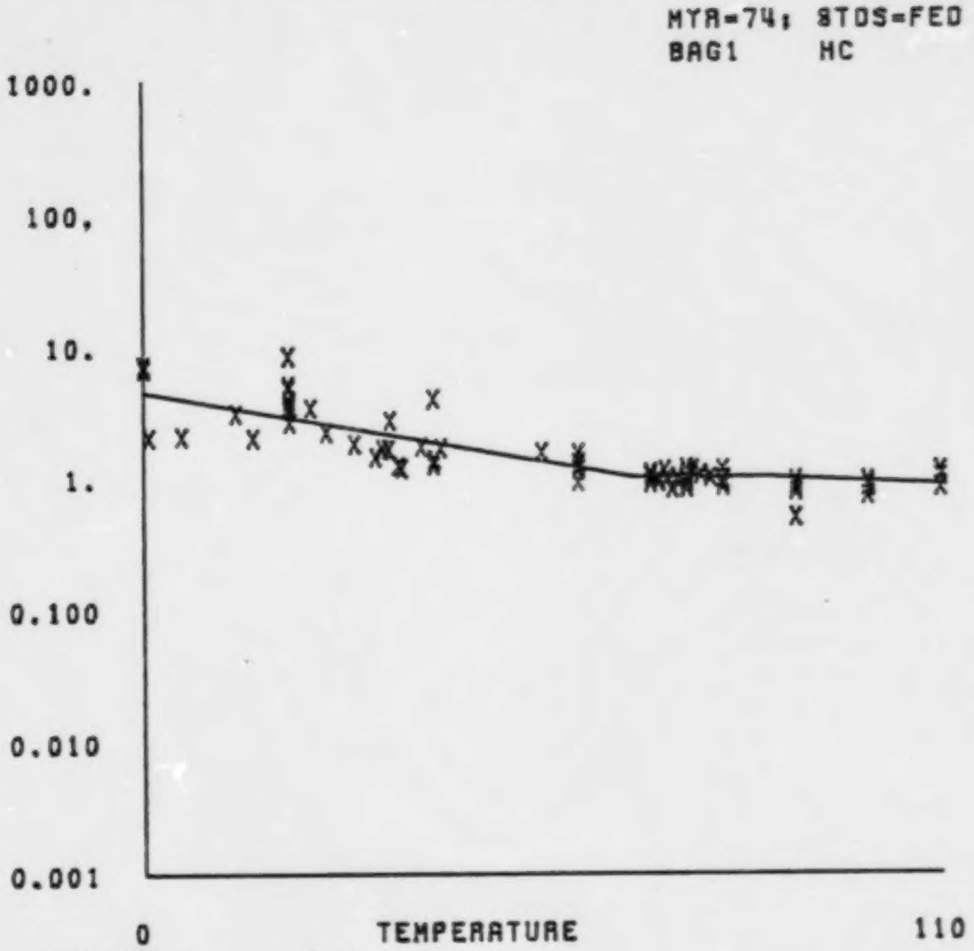
EXHIBIT 2.16

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC 73FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	4.3821
5.0	3.9278
10.0	3.5206
15.0	3.1557
20.0	2.8285
25.0	2.5353
30.0	2.2724
35.0	2.0369
40.0	1.8257
45.0	1.6364
50.0	1.4668
55.0	1.3147
60.0	1.1784
65.0	1.0562
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9772
95.0	0.9455
100.0	0.9149
105.0	0.8852
110.0	0.8565

EXHIBIT 2.17



```
MIN TEMP =   -6.9
MAX TEMP = 110.00

N(LOW TEMP) 37           STD ERROR(LOW TEMP)    44.82%
N(FTP TEMP) 29           STD ERROR(FTP TEMP)    12.51%
N(HIGHTEMP) 12           STD ERROR(HIGHTEMP)    24.22%

     EFFECT(LOW TEMP)  = EXP(-0.022042(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.005794(TEMP-86.5))
```

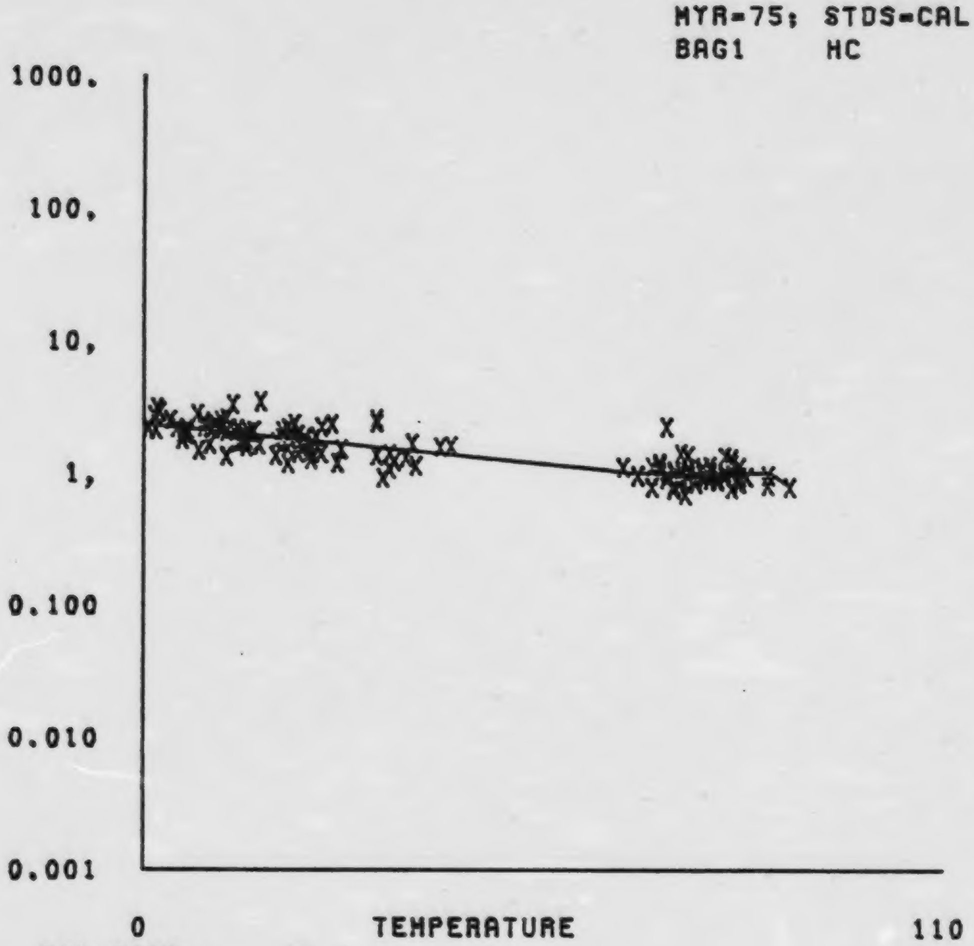
EXHIBIT 2.18

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC 74FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	4.4274
5.0	3.9654
10.0	3.5516
15.0	3.1810
20.0	2.8490
25.0	2.5517
30.0	2.2855
35.0	2.0470
40.0	1.8334
45.0	1.6420
50.0	1.4707
55.0	1.3172
60.0	1.1798
65.0	1.0567
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9799
95.0	0.9519
100.0	0.9248
105.0	0.8984
110.0	0.8727

EXHIBIT 2.19



MIN TEMP = -7.1
MAX TEMP = 89.00

N(LOW TEMP)	90	STD ERROR(LOW TEMP)	22.45%
N(FTP TEMP)	54	STD ERROR(FTP TEMP)	18.91%
N(HIGHTEMP)	1	STD ERROR(HIGHTEMP)	0.0 %

EFFECT(LOW TEMP) = EXP(-0.012282 (TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(-0.093562 (TEMP-86.5))

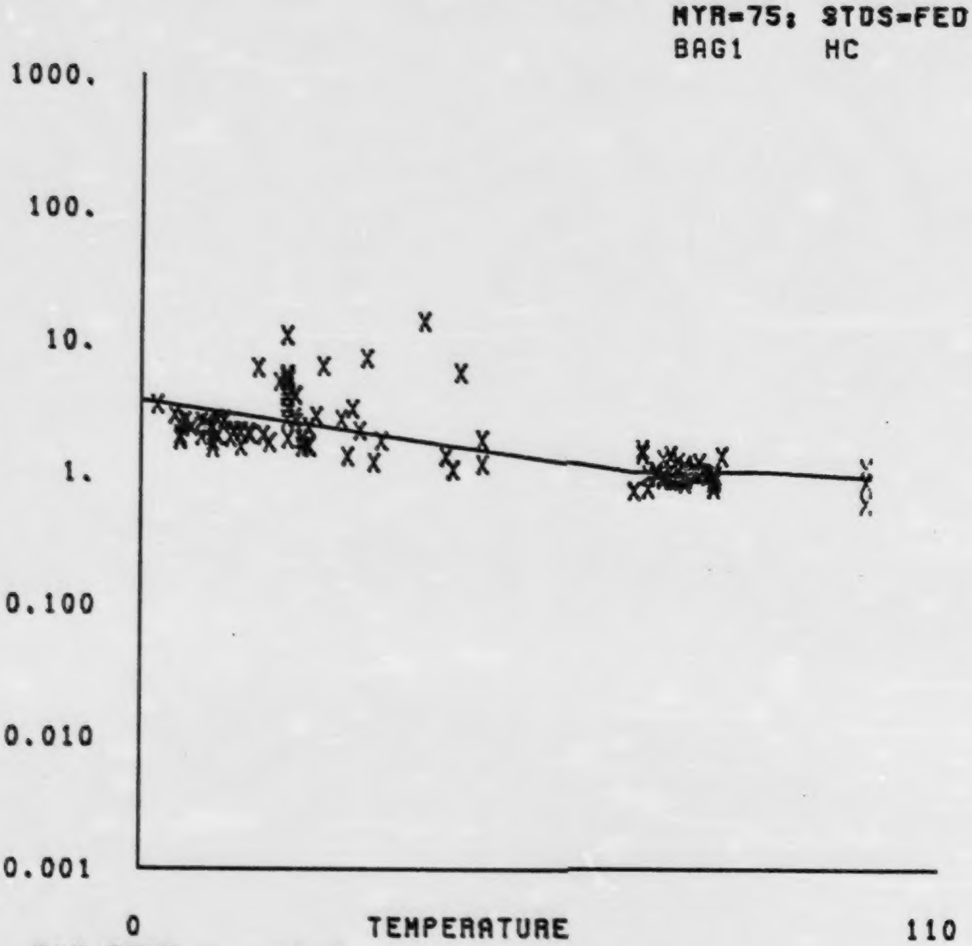
EXHIBIT 2.20

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC 75CAL

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.2911
5.0	2.1546
10.0	2.0263
15.0	1.9056
20.0	1.7921
25.0	1.6854
30.0	1.5850
35.0	1.4906
40.0	1.4018
45.0	1.3183
50.0	1.2398
55.0	1.1659
60.0	1.0965
65.0	1.0312
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.7207
95.0	0.4515
100.0	0.2828
105.0	0.1771
110.0	0.1109

EXHIBIT 2.21



```
MIN TEMP =   -5.8
MAX TEMP = 100.00

N(LOW TEMP) 70                STD ERROR(LOW TEMP)    55.51%
N(FTP TEMP) 62                STD ERROR(FTP TEMP)    17.67%
N(HIGHTEMP) 11                STD ERROR(HIGHTEMP)    22.92%

    EFFECT(LOW TEMP) = EXP(-0.018109  (TEMP-67.5))
    EFFECT(HIGHTEMP) = EXP(-0.007671(TEMP-86.5))
```

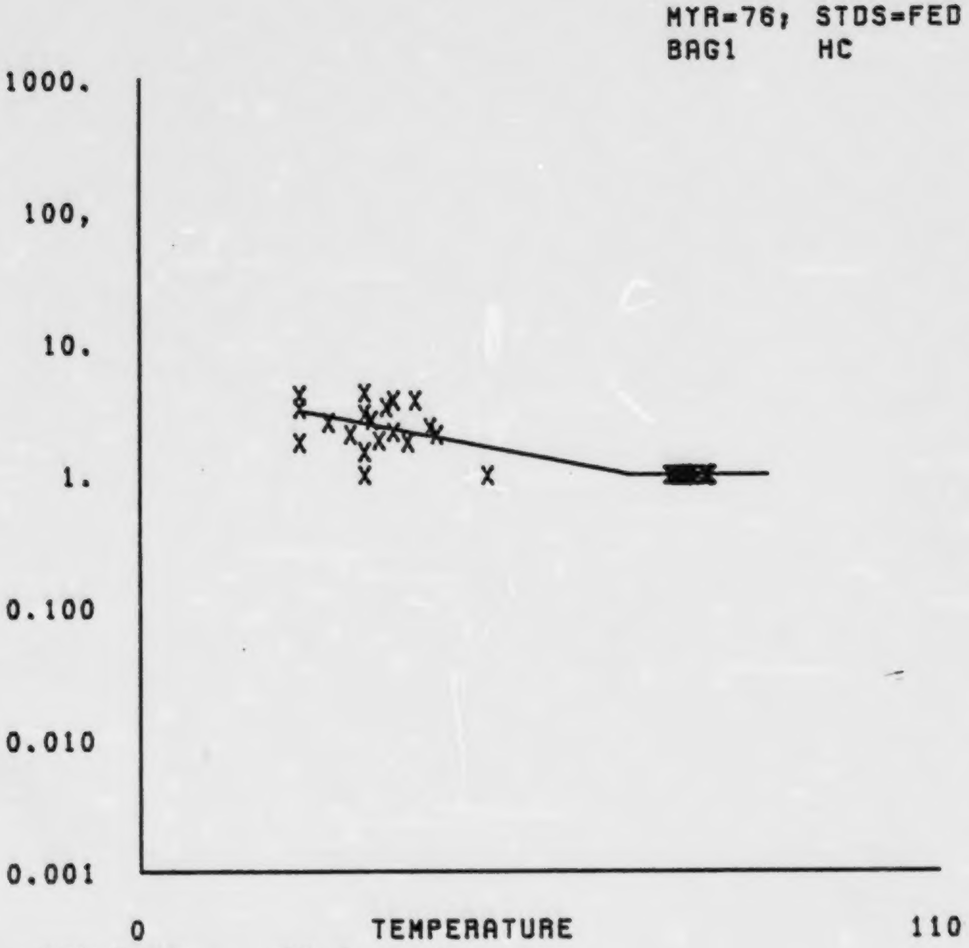
EXHIBIT 2.22

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC 75FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	3.3951
5.0	3.1012
10.0	2.8327
15.0	2.5875
20.0	2.3635
25.0	2.1589
30.0	1.9720
35.0	1.8013
40.0	1.6454
45.0	1.5030
50.0	1.3729
55.0	1.2540
60.0	1.1455
65.0	1.0463
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9735
95.0	0.9369
100.0	0.9016
105.0	0.8677
110.0	0.8350

EXHIBIT 2.23



```
MIN TEMP =   22.0
MAX TEMP =  78.70

N(LOW TEMP) 19              STD ERROR(LOW TEMP)     39.07%
N(FTP TEMP) 19              STD ERROR(FTP TEMP)      0.0 %
N(HIGHTEMP) 0               STD ERROR(HIGHTEMP)      0.0 %

      EFFECT(LOW TEMP)  = EXP(-0.024489(TEMP-67.5))
```

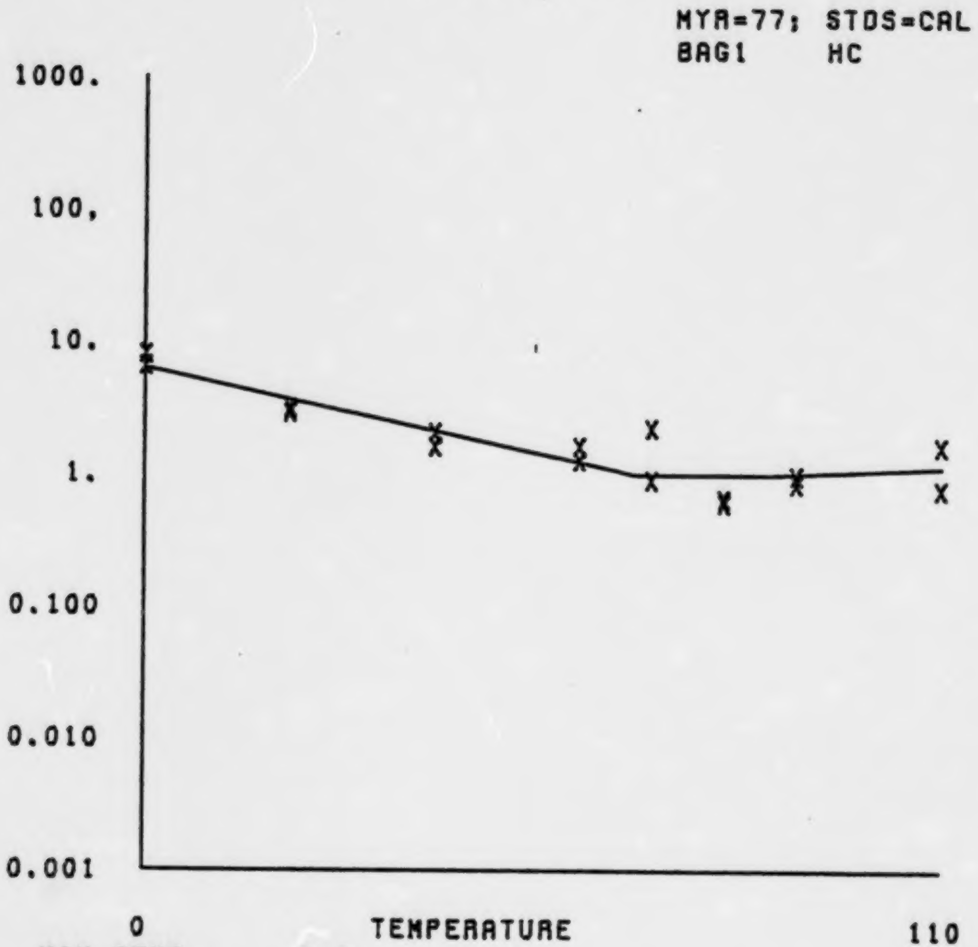
EXHIBIT 2.24

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC 76FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	5.2227
5.0	4.6208
10.0	4.0883
15.0	3.6171
20.0	3.2003
25.0	2.8314
30.0	2.5051
35.0	2.2164
40.0	1.9610
45.0	1.7350
50.0	1.5350
55.0	1.3581
60.0	1.2016
65.0	1.0631
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	NO DATA
95.0	" "
100.0	" "
105.0	" "
110.0	" "

EXHIBIT 2.25



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 8               STD ERROR(LOW TEMP)    18.62%
N(FTP TEMP) 4               STD ERROR(FTP TEMP)    60.04%
N(HIGHTEMP) 4               STD ERROR(HIGHTEMP)    28.04%

     EFFECT(LOW TEMP) = EXP(-0.027181(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP( 0.005229(TEMP-86.5))
```

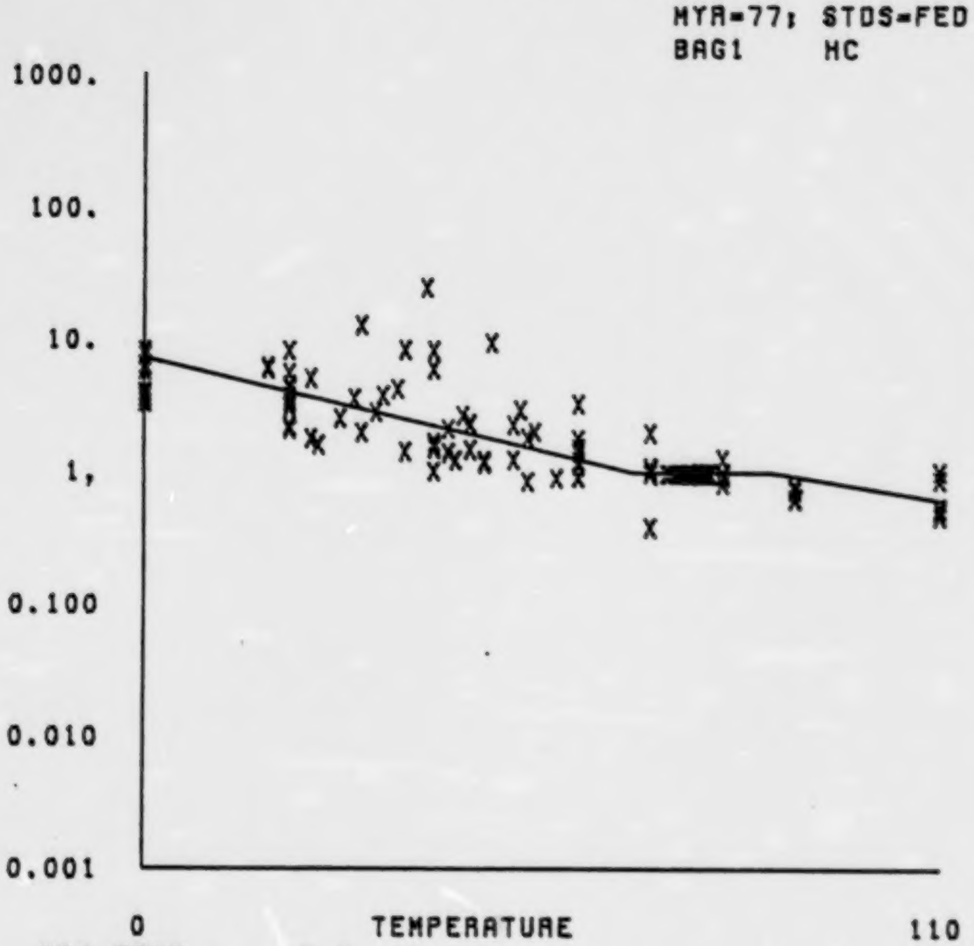
EXHIBIT 2.26

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC 77CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	6.2632
5.0	5.4673
10.0	4.7726
15.0	4.1661
20.0	3.6367
25.0	3.1746
30.0	2.7712
35.0	2.4190
40.0	2.1116
45.0	1.8433
50.0	1.6091
55.0	1.4046
60.0	1.2261
65.0	1.0703
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0185
95.0	1.0454
100.0	1.0731
105.0	1.1016
110.0	1.1307

EXHIBIT 2.27



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 65             STD ERROR(LOW TEMP)    62.06%
N(FTP TEMP) 48             STD ERROR(FTP TEMP)    38.99%
N(HIGHTEMP) 12             STD ERROR(HIGHTEMP)    29.54%

     EFFECT(LOW TEMP) = EXP(-0.029241(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.020752(TEMP-86.5))
```

EXHIBIT 2.28

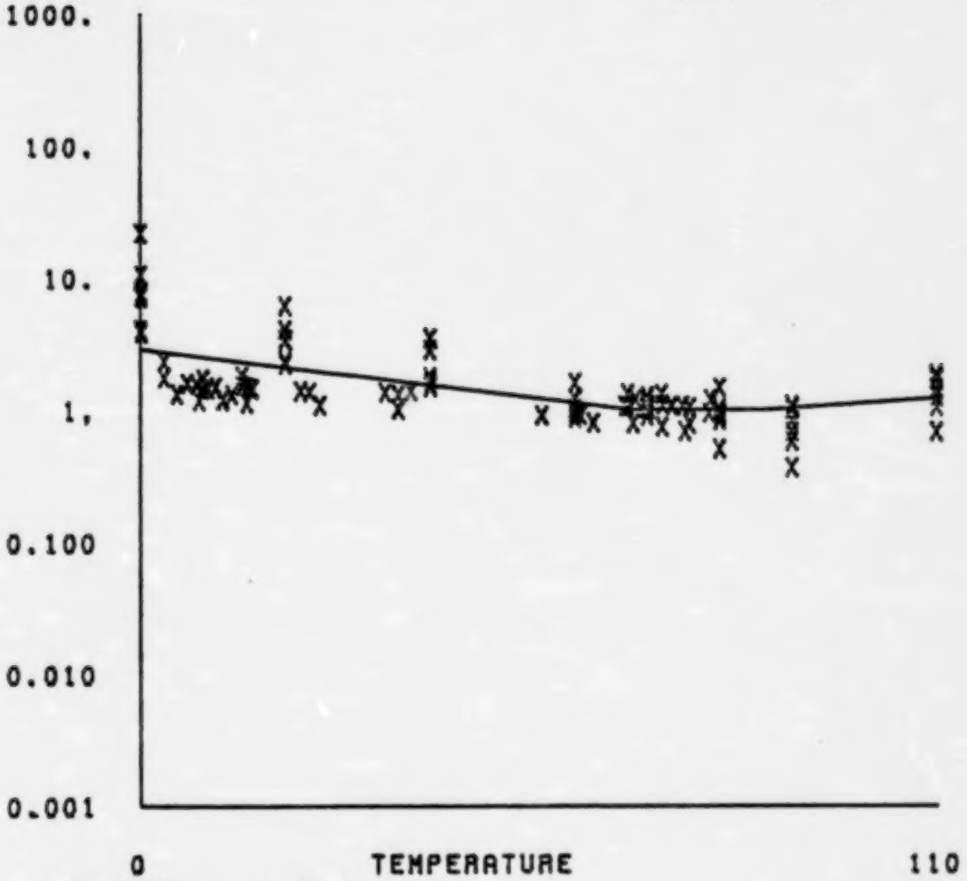
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC 77FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	7.1979
5.0	6.2189
10.0	5.3730
15.0	4.6421
20.0	4.0107
25.0	3.4652
30.0	2.9938
35.0	2.5866
40.0	2.2348
45.0	1.9308
50.0	1.6682
55.0	1.4413
60.0	1.2452
65.0	1.0758
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9299
95.0	0.8383
100.0	0.7557
105.0	0.6812
110.0	0.6141

EXHIBIT 2.29

MYR-78; STDS-CAL
BAG1 HC



MIN TEMP = -3.8
MAX TEMP = 110.00

N (LOW TEMP) 57
N (FTP TEMP) 28
N (HIGHTEMP) 13

STD ERROR (LOW TEMP) 58.00%
STD ERROR (FTP TEMP) 23.18%
STD ERROR (HIGHTEMP) 41.70%

EFFECT (LOW TEMP) = EXP (-0.015645 (TEMP-67.5))
EFFECT (HIGHTEMP) = EXP (0.008320 (TEMP-86.5))

EXHIBIT 2.30

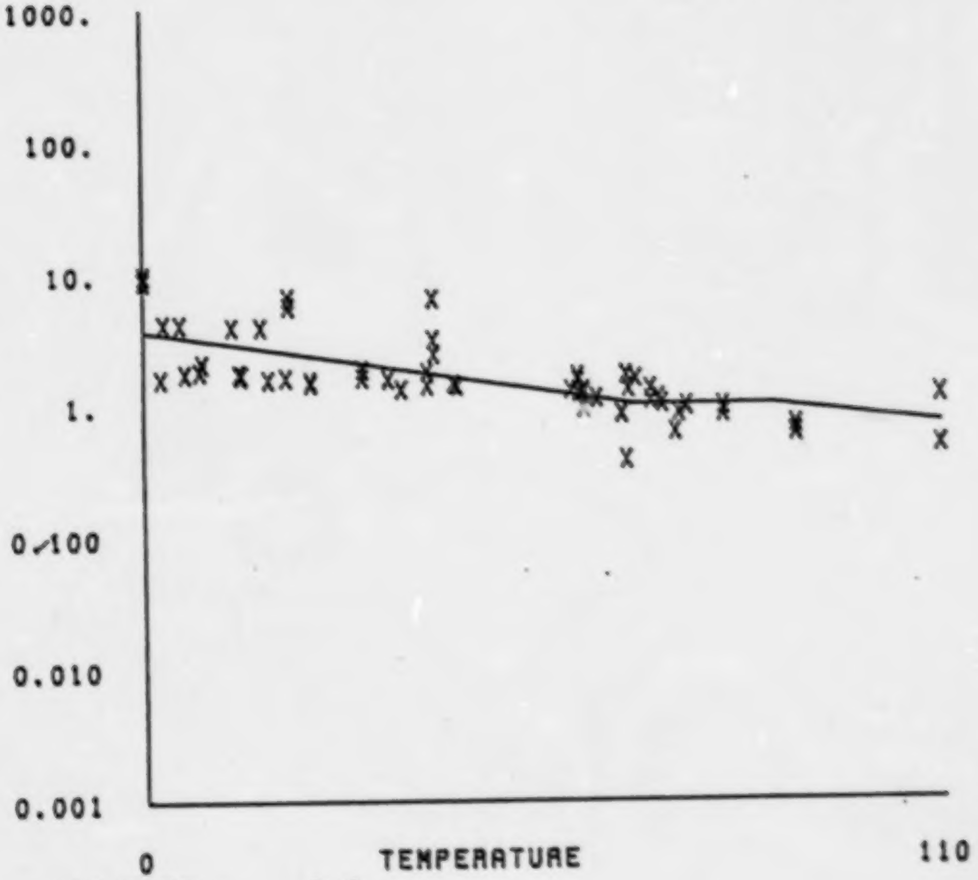
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC 78CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.8749
5.0	2.6586
10.0	2.4586
15.0	2.2736
20.0	2.1025
25.0	1.9443
30.0	1.7980
35.0	1.6627
40.0	1.5376
45.0	1.4219
50.0	1.3149
55.0	1.2160
60.0	1.1245
65.0	1.0399
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0295
95.0	1.0733
100.0	1.1189
105.0	1.1664
110.0	1.2159

EXHIBIT 2.31

MYR=78; STDS=FED
BAG1 HC



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 42          STD ERROR(LOW TEMP)    51.14%
N(FTP TEMP) 10          STD ERROR(FTP TEMP)    31.20%
N(HIGHTEMP) 4           STD ERROR(HIGHTEMP)    41.30%

     EFFECT(LOW TEMP)  = EXP(-0.019251(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.014679(TEMP-86.5))
```

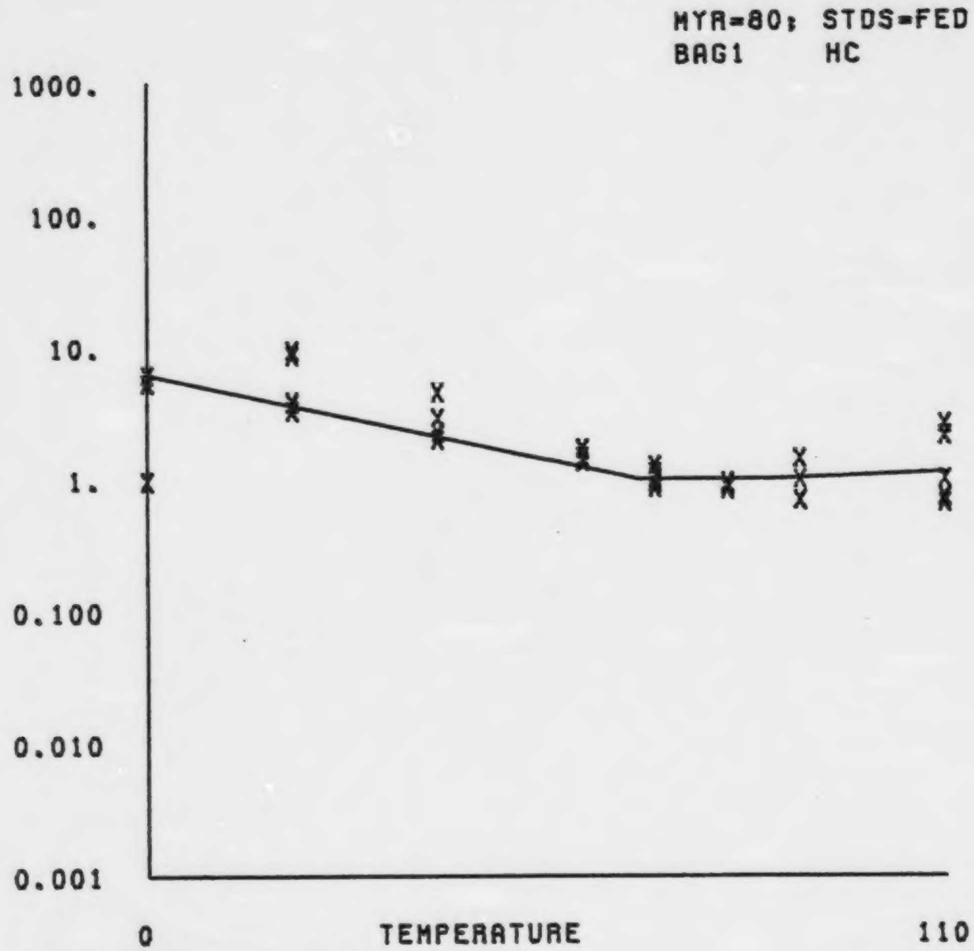
EXHIBIT 2.32

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC   78FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	3.6672
5.0	3.3307
10.0	3.0250
15.0	2.7474
20.0	2.4953
25.0	2.2663
30.0	2.0583
35.0	1.8695
40.0	1.6979
45.0	1.5421
50.0	1.4006
55.0	1.2721
60.0	1.1553
65.0	1.0493
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9499
95.0	0.8827
100.0	0.8202
105.0	0.7622
110.0	0.7083

EXHIBIT 2.33



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 17              STD ERROR(LOW TEMP)    60.56%
N(FTP TEMP) 11              STD ERROR(FTP TEMP)    14.25%
N(HIGHTEMP) 10              STD ERROR(HIGHTEMP)    47.03%

     EFFECT(LOW TEMP)  = EXP(-0.026803(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.004832(TEMP-86.5))
```

EXHIBIT 2.34

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF HC   80FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	6.1057
5.0	5.3399
10.0	4.6702
15.0	4.0844
20.0	3.5721
25.0	3.1241
30.0	2.7322
35.0	2.3896
40.0	2.0898
45.0	1.8277
50.0	1.5985
55.0	1.3980
60.0	1.2227
65.0	1.0693
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0171
95.0	1.0419
100.0	1.0674
105.0	1.0935
110.0	1.1203

EXHIBIT 2.35: FITTED TEMPERATURE EFFECTS, HC BAG2

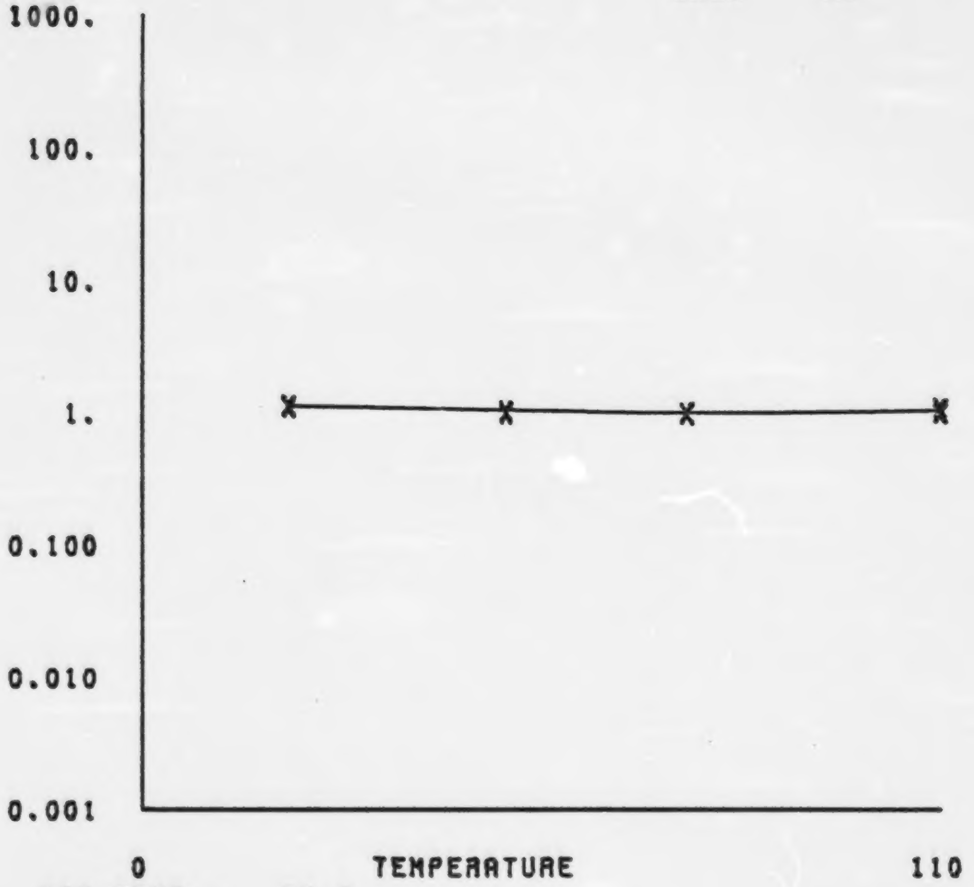
$$\frac{\text{EMISSIONS AT TEMPERATURE T}}{\text{EMISSIONS AT FTP TEMPERATURE}} = \begin{cases} \exp[c(T-67.5)] & \text{for T less than 67.5} \\ \exp[d(T-86.5)] & \text{for T greater than 86.5} \end{cases}$$

where exp is the exponential function and c and d are as tabled below.

MYR STDS	c	d
67FED	-.00240319	.00132192
69FED	-.00320166	.00426668
70FED	-.00062057	-.00038962
71FED	-.00049024	-.00051498
72FED	-.00012446	.00621156
73FED	-.00255528	.00319551
74FED	.00025819	.00084378
75CAL	-.00843646	.10550440
75FED	-.00868937	.01781010
76FED	-.00111482	NO DATA
77CAL	-.00222544	.02164413
77FED	-.01193854	.03367804
78CAL	-.00472121	.02017063
78FED	-.00607105	.02229625
80FED	-.00441651	.00322301

EXHIBIT 2.36

MYR=67; STDS=FED
BAG2 HC



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 6              STD ERROR(LOW TEMP)     2.78%
N(FTP TEMP) 3              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 3              STD ERROR(HIGHTEMP)     4.41%

     EFFECT(LOW TEMP)  = EXP(-0.002403(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.001322(TEMP-86.5))
```

EXHIBIT 2.37

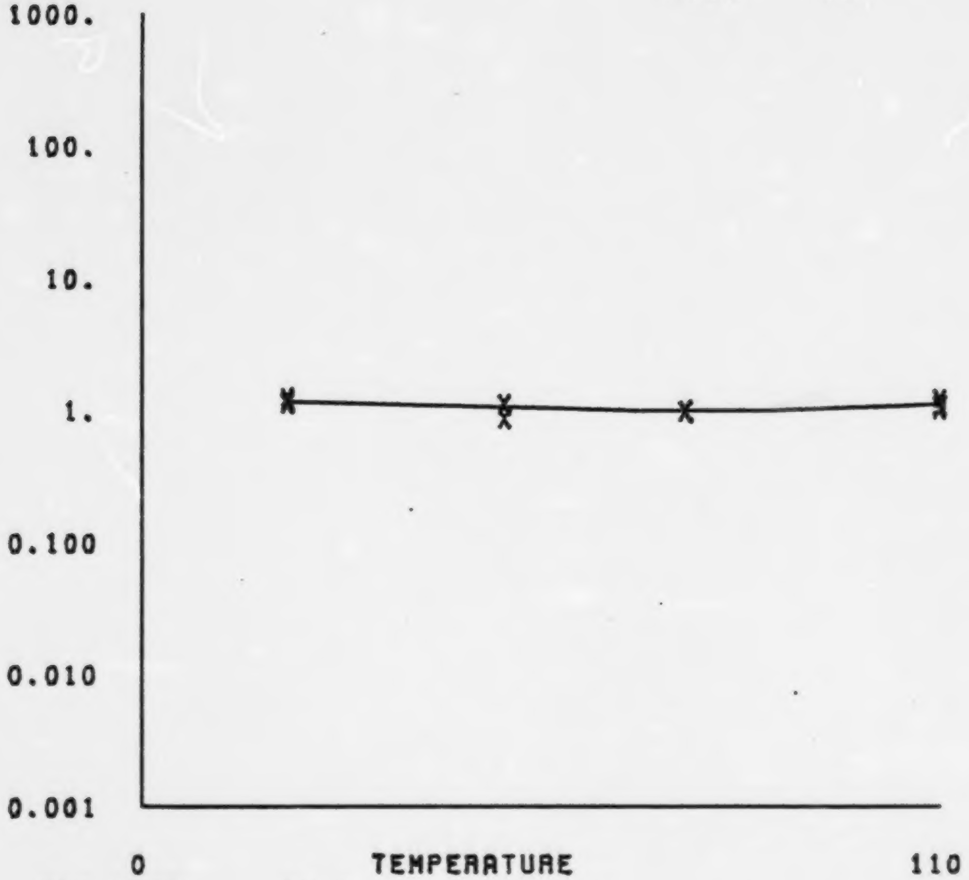
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 67FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.1761
5.0	1.1621
10.0	1.1482
15.0	1.1345
20.0	1.1209
25.0	1.1075
30.0	1.0943
35.0	1.0812
40.0	1.0683
45.0	1.0556
50.0	1.0430
55.0	1.0305
60.0	1.0182
65.0	1.0060
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0046
95.0	1.0113
100.0	1.0180
105.0	1.0248
110.0	1.0316

EXHIBIT 2.38

MYR=69; STDS=FED
BAG2 HC



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 8               STD ERROR(LOW TEMP)    10.24%
N(FTP TEMP) 4               STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 4               STD ERROR(HIGHTEMP)     8.56%

     EFFECT(LOW TEMP)  = EXP(-0.003202(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.004267(TEMP-86.5))
```

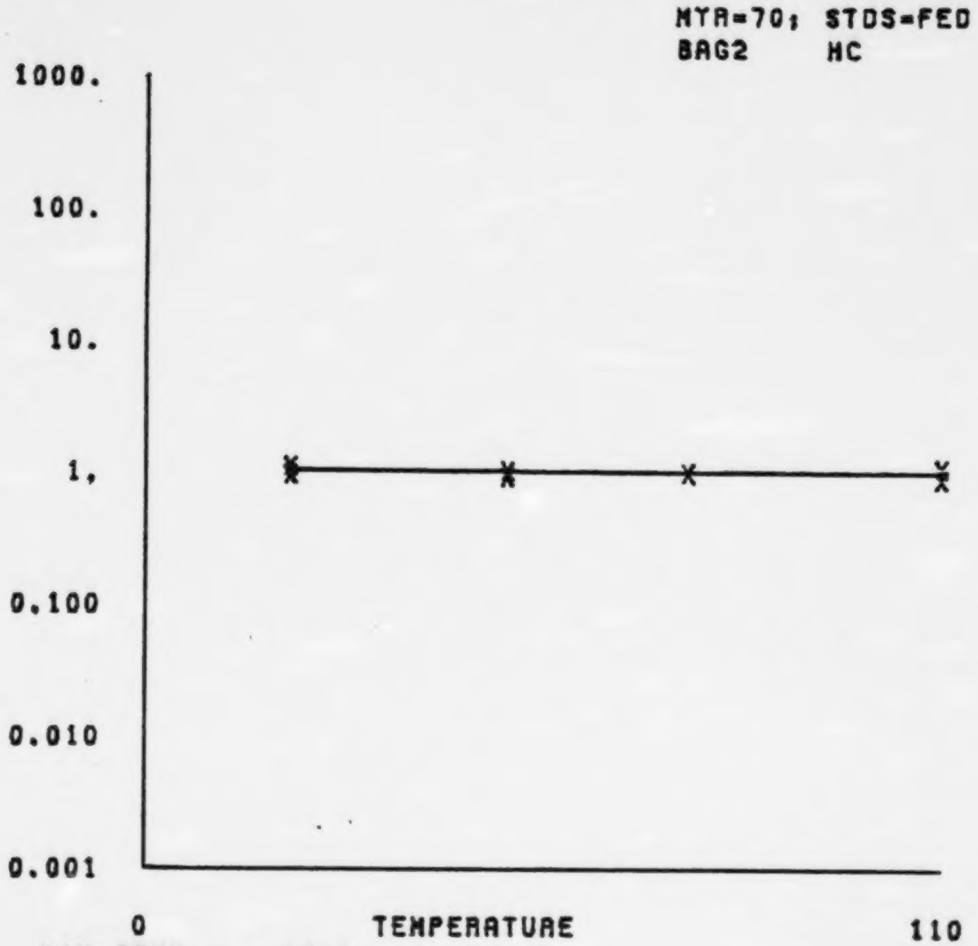
EXHIBIT 2.39

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 69FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.2412
5.0	1.2215
10.0	1.2021
15.0	1.1830
20.0	1.1643
25.0	1.1458
30.0	1.1276
35.0	1.1097
40.0	1.0920
45.0	1.0747
50.0	1.0576
55.0	1.0408
60.0	1.0243
65.0	1.0080
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0150
95.0	1.0369
100.0	1.0593
105.0	1.0821
110.0	1.1055

EXHIBIT 2.40



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 4                STD ERROR(LOW TEMP)     6.87%
N(FTP TEMP) 2                STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 2                STD ERROR(HIGHTEMP)     9.46%

     EFFECT(LOW TEMP) = EXP(-0.000621(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.000390(TEMP-86.5))
```

EXHIBIT 2.41

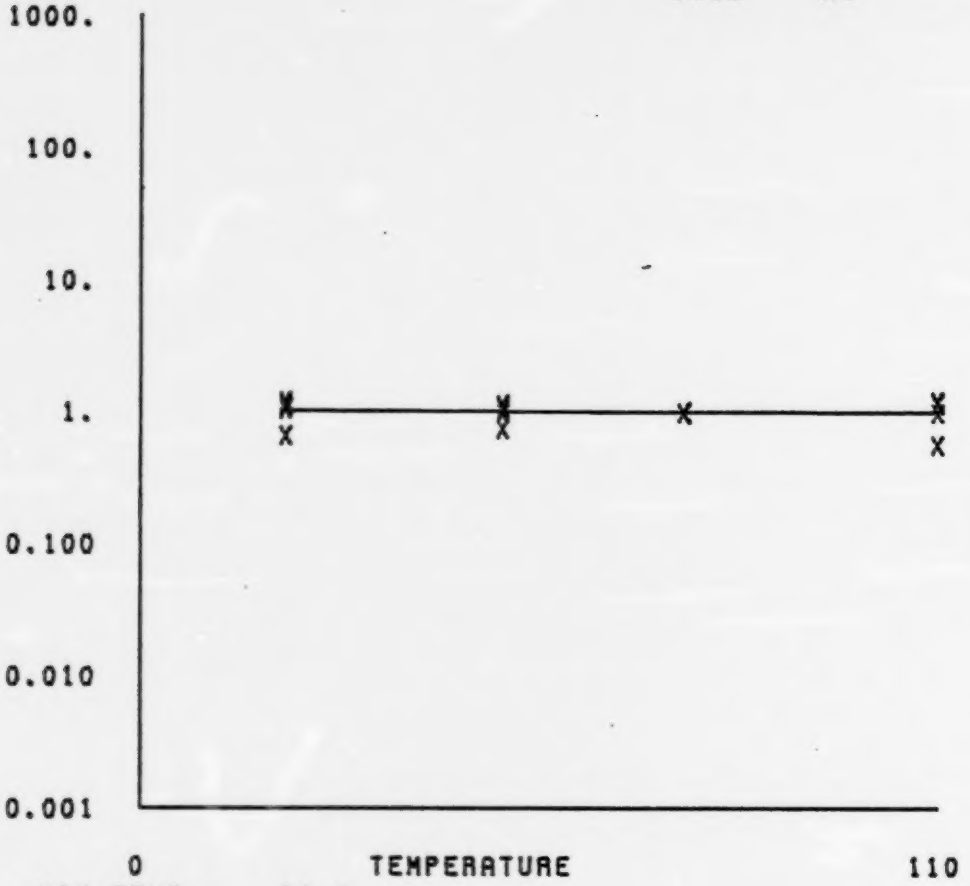
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC   70FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0428
5.0	1.0395
10.0	1.0363
15.0	1.0331
20.0	1.0299
25.0	1.0267
30.0	1.0235
35.0	1.0204
40.0	1.0172
45.0	1.0141
50.0	1.0109
55.0	1.0078
60.0	1.0047
65.0	1.0016
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9986
95.0	0.9967
100.0	0.9948
105.0	0.9928
110.0	0.9909

EXHIBIT 2.42

MYR=71; STDS=FED
BAG2 HC



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 10          STD ERROR(LOW TEMP)    18.89%
N(FTP TEMP) 5           STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 5           STD ERROR(HIGHTEMP)    28.55%

     EFFECT(LOW TEMP)  = EXP(-0.000490(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.000515(TEMP-86.5))
```

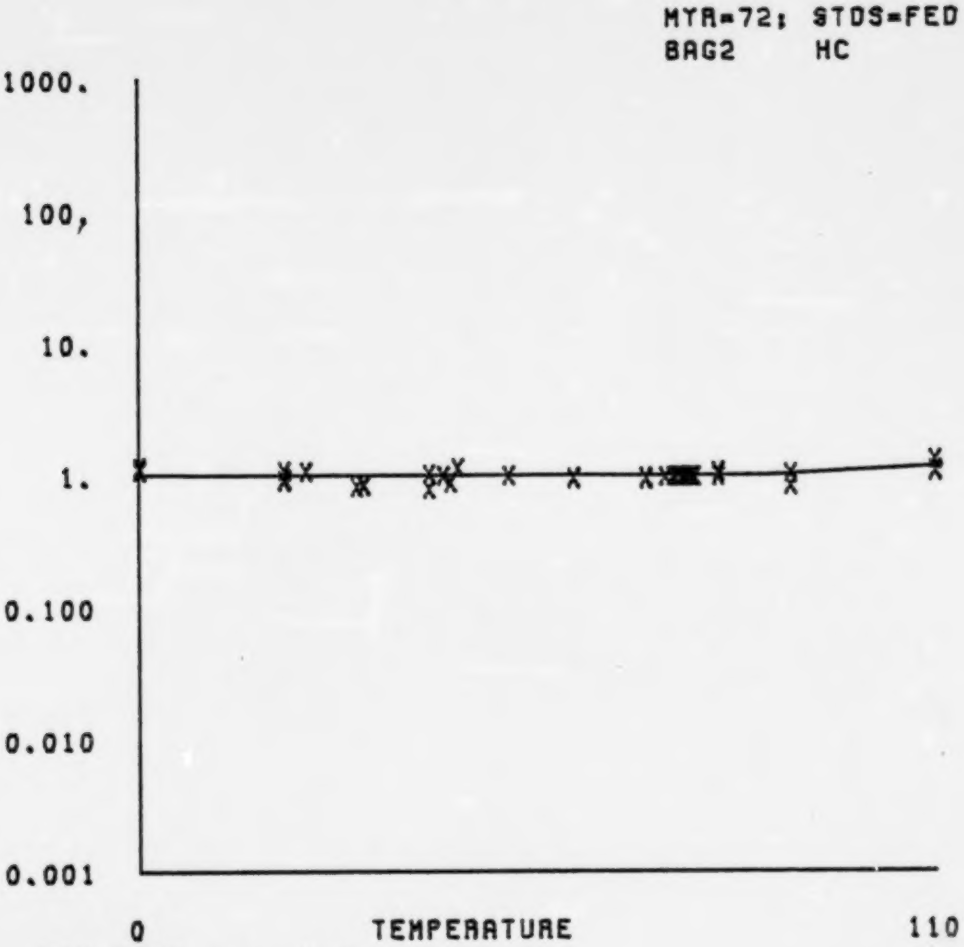
EXHIBIT 2.43

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 71FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0336
5.0	1.0311
10.0	1.0286
15.0	1.0261
20.0	1.0236
25.0	1.0211
30.0	1.0186
35.0	1.0161
40.0	1.0136
45.0	1.0111
50.0	1.0086
55.0	1.0061
60.0	1.0037
65.0	1.0012
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9982
95.0	0.9956
100.0	0.9931
105.0	0.9905
110.0	0.9880

EXHIBIT 2.44



MIN TEMP = 0.0
MAX TEMP = 110.00

N(LOW TEMP) 16 STD ERROR(LOW TEMP) 11.25%
N(FTP TEMP) 12 STD ERROR(FTP TEMP) 5.60%
N(HIGHTEMP) 5 STD ERROR(HIGHTEMP) 10.81%

EFFECT(LOW TEMP) = EXP(-0.000124(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(0.006212(TEMP-86.5))

EXHIBIT 2.45

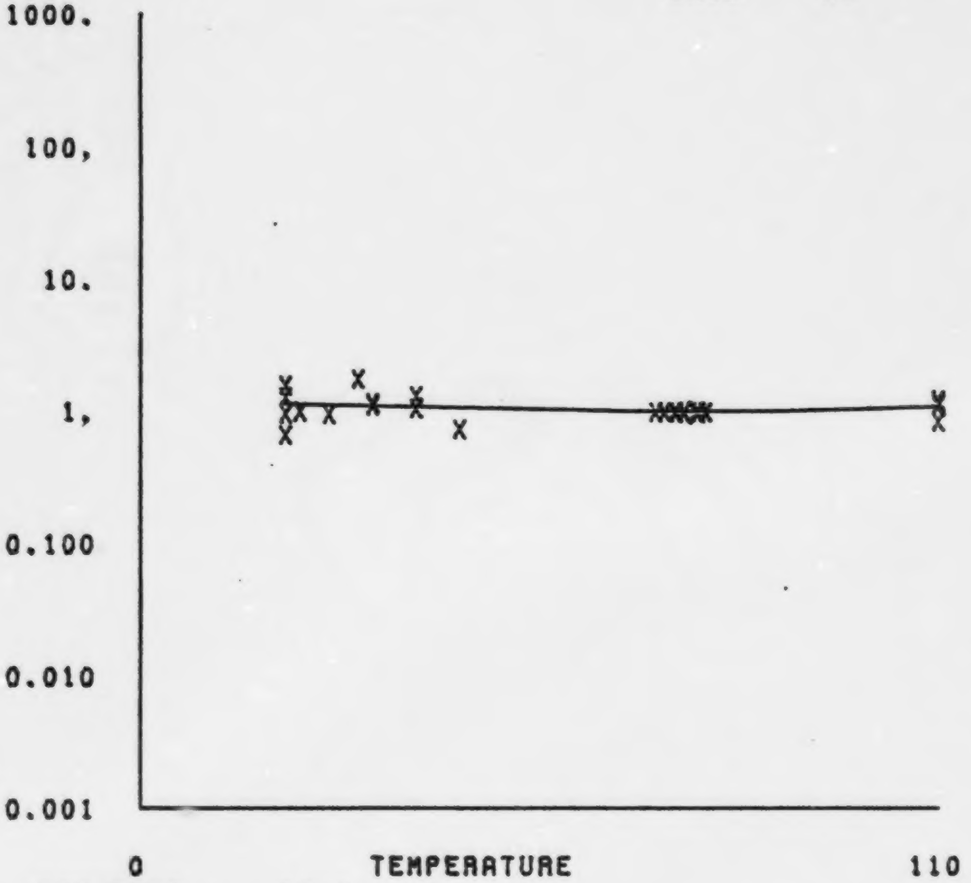
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 72FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0084
5.0	1.0078
10.0	1.0072
15.0	1.0066
20.0	1.0059
25.0	1.0053
30.0	1.0047
35.0	1.0041
40.0	1.0034
45.0	1.0028
50.0	1.0022
55.0	1.0016
60.0	1.0009
65.0	1.0003
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0220
95.0	1.0542
100.0	1.0875
105.0	1.1218
110.0	1.1572

EXHIBIT 2.46

MYR=73; STDS=FED
BAG2 HC



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 12               STD ERROR(LOW TEMP)    26.83%
N(FTP TEMP) 12               STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 4                STD ERROR(HIGHTEMP)    13.93%

     EFFECT(LOW TEMP)  = EXP(-0.002555(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.003196(TEMP-86.5))
```

EXHIBIT 2.47

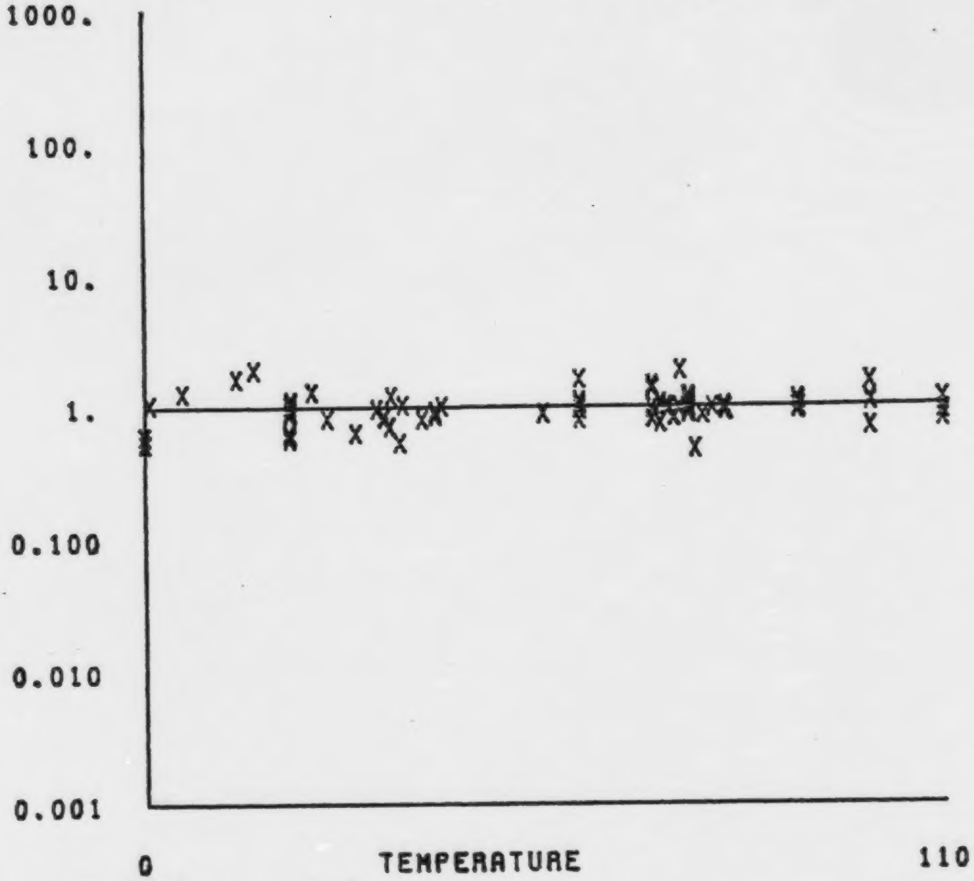
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 73FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.1882
5.0	1.1732
10.0	1.1583
15.0	1.1436
20.0	1.1290
25.0	1.1147
30.0	1.1006
35.0	1.0866
40.0	1.0728
45.0	1.0592
50.0	1.0457
55.0	1.0325
60.0	1.0193
65.0	1.0064
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0112
95.0	1.0275
100.0	1.0441
105.0	1.0609
110.0	1.0780

EXHIBIT 2.48

MYR=74; STDS=FED
BAG2 HC



```
MIN TEMP =   -6.9
MAX TEMP = 110.00

N(LOW TEMP) 37                STD ERROR(LOW TEMP)    36.55%
N(FTP TEMP) 29                STD ERROR(FTP TEMP)    29.93%
N(HIGHTEMP) 12                STD ERROR(HIGHTEMP)    19.40%

      EFFECT(LOW TEMP)  = EXP( 0.000258(TEMP-67.5))
      EFFECT(HIGHTEMP)  = EXP( 0.000844(TEMP-66.5))
```

EXHIBIT 2.49

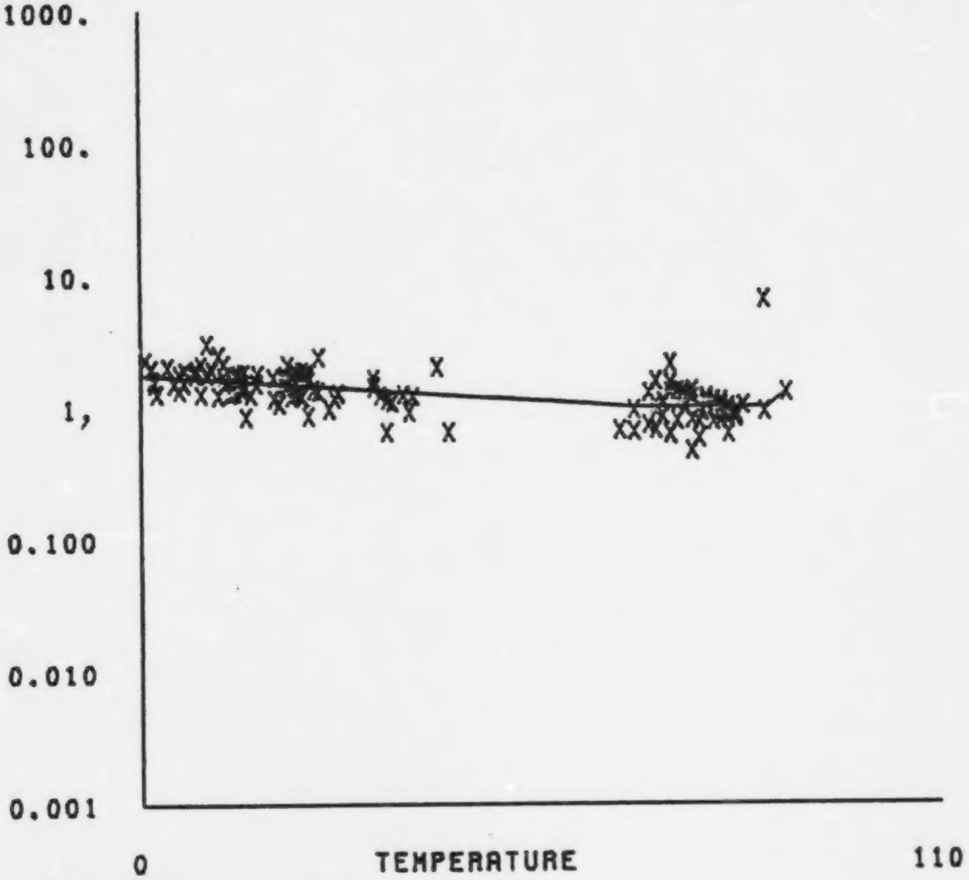
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 74FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9827
5.0	0.9840
10.0	0.9853
15.0	0.9865
20.0	0.9878
25.0	0.9891
30.0	0.9904
35.0	0.9916
40.0	0.9929
45.0	0.9942
50.0	0.9955
55.0	0.9968
60.0	0.9981
65.0	0.9994
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0030
95.0	1.0072
100.0	1.0115
105.0	1.0157
110.0	1.0200

EXHIBIT 2.50

MYR=75; STDS=CAL
BAG2 HC



```
MIN TEMP =   -7.1
MAX TEMP =   89.00

N(LOW TEMP)  90              STD ERROR(LOW TEMP)     25.71%
N(FTP TEMP)  53              STD ERROR(FTP TEMP)     38.55%
N(HIGHTEMP)  1               STD ERROR(HIGHTEMP)      0.0 %

     EFFECT(LOW TEMP)  = EXP(-0.008436(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.105504(TEMP-86.5))
```

EXHIBIT 2.51

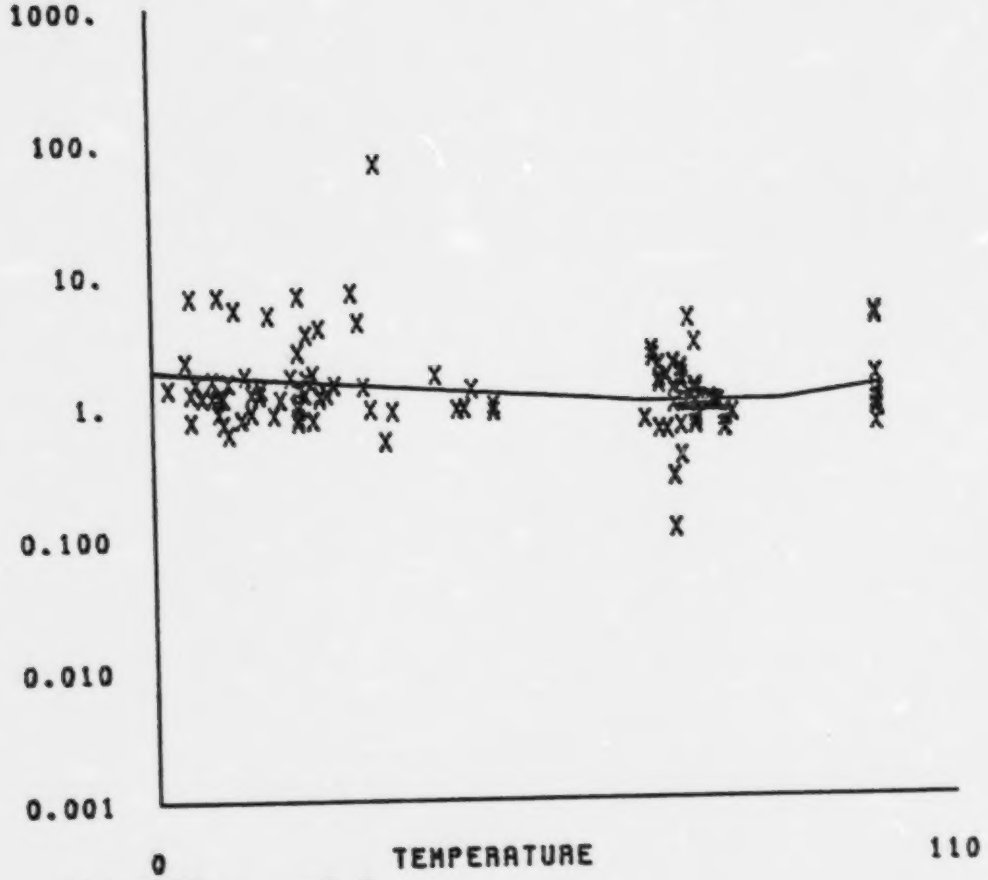
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 75CAL

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.7673
5.0	1.6943
10.0	1.6243
15.0	1.5572
20.0	1.4929
25.0	1.4313
30.0	1.3721
35.0	1.3155
40.0	1.2611
45.0	1.2090
50.0	1.1591
55.0	1.1112
60.0	1.0653
65.0	1.0213
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.4467
95.0	2.4517
100.0	4.1550
105.0	7.0416
110.0	11.9335

EXHIBIT 2.52

MYR=75; STDS=FED
BAG2 HC



MIN TEMP = -5.8
MAX TEMP = 100.00

N(LOW TEMP) 70
N(FTP TEMP) 80
N(HIGHTEMP) 11

STD ERROR(LOW TEMP) 74.82%
STD ERROR(FTP TEMP) 70.05%
STD ERROR(HIGHTEMP) 61.66 %

EFFECT(LOW TEMP) = EXP(-0.008689(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(0.017810(TEMP-86.5))

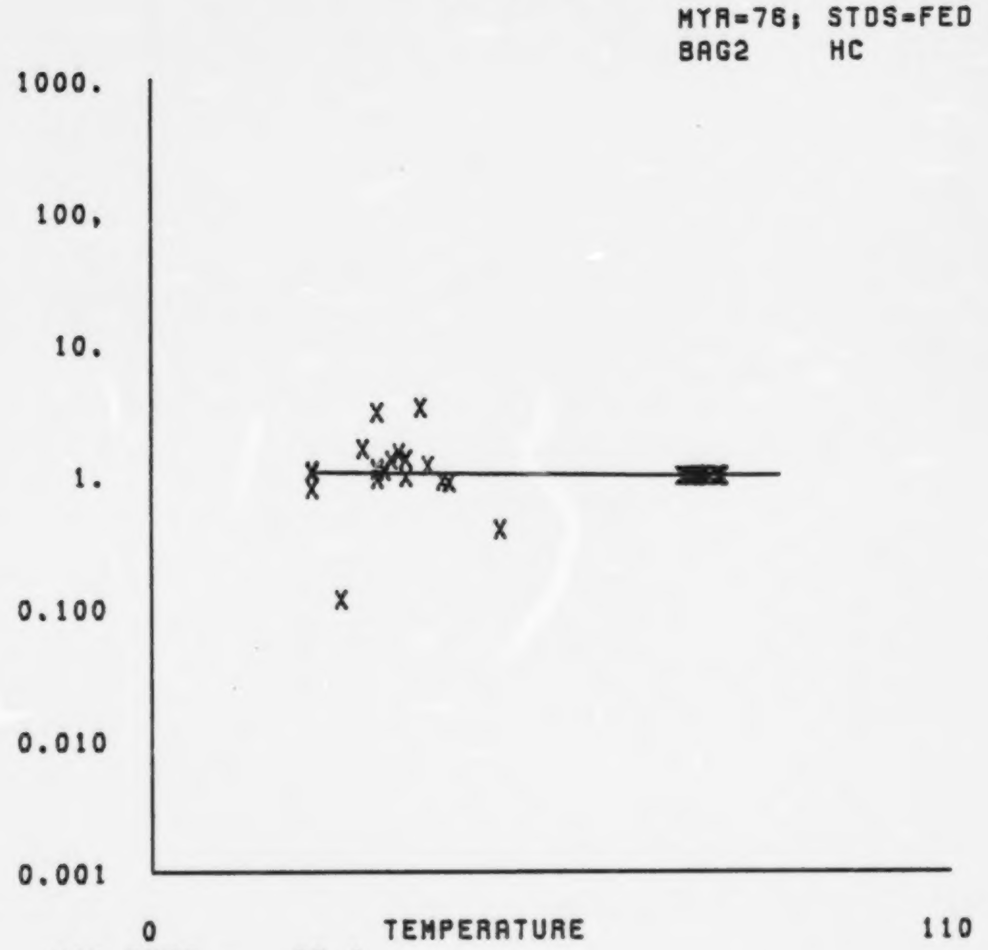
EXHIBIT 2.53

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 75FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.7977
5.0	1.7213
10.0	1.6481
15.0	1.5781
20.0	1.5110
25.0	1.4467
30.0	1.3852
35.0	1.3263
40.0	1.2699
45.0	1.2159
50.0	1.1642
55.0	1.1147
60.0	1.0673
65.0	1.0220
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0643
95.0	1.1634
100.0	1.2718
105.0	1.3903
110.0	1.5197

EXHIBIT 2.54



```
MIN TEMP =   22.0
MAX TEMP =  78.70

N(LOW TEMP) 19          STD ERROR(LOW TEMP)    68.07%
N(FTP TEMP) 19          STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 0           STD ERROR(HIGHTEMP)     0.0 %

     EFFECT(LOW TEMP) = EXP(-0.001115(TEMP-67.5))
```

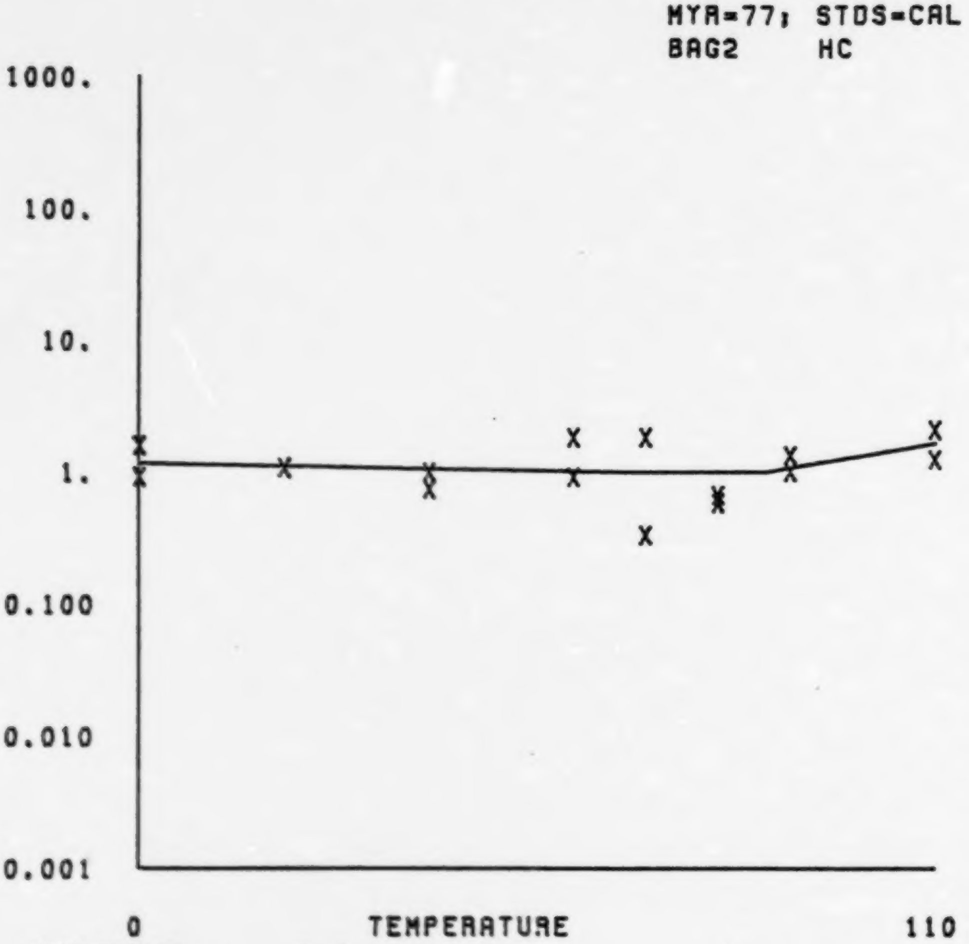
EXHIBIT 2.55

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 76FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0782
5.0	1.0722
10.0	1.0662
15.0	1.0603
20.0	1.0544
25.0	1.0485
30.0	1.0427
35.0	1.0369
40.0	1.0311
45.0	1.0254
50.0	1.0197
55.0	1.0140
60.0	1.0084
65.0	1.0028
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	No data
95.0	" " " "
100.0	" "
105.0	" "
110.0	" "

EXHIBIT 2.56



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N (LOW TEMP)  8              STD ERROR (LOW TEMP)    28.34%
N (FTP TEMP)  4              STD ERROR (FTP TEMP)    81.25 %
N (HIGHTEMP)  4              STD ERROR (HIGHTEMP)    21.61%

     EFFECT (LOW TEMP)  = EXP (-0.002225 (TEMP-67.5))
     EFFECT (HIGHTEMP)  = EXP ( 0.021644 (TEMP-86.5))
```

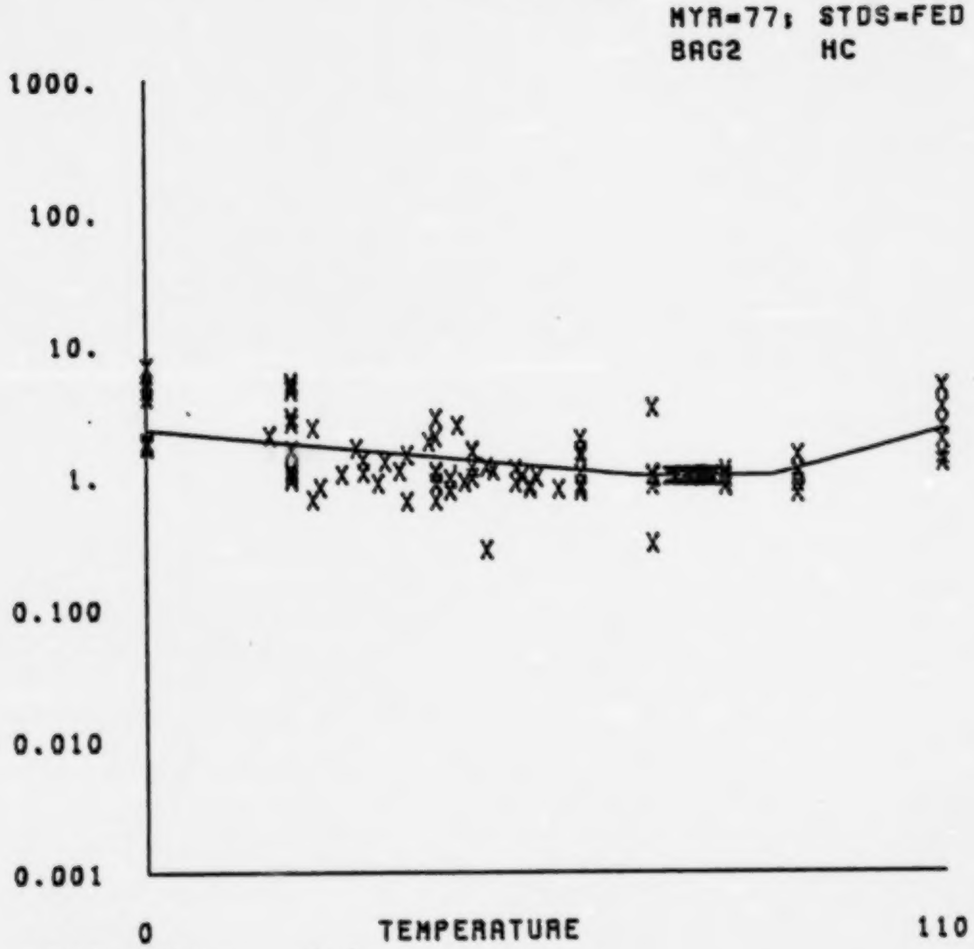
EXHIBIT 2.57

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 77CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.1621
5.0	1.1492
10.0	1.1365
15.0	1.1239
20.0	1.1115
25.0	1.0992
30.0	1.0870
35.0	1.0750
40.0	1.0631
45.0	1.0513
50.0	1.0397
55.0	1.0282
60.0	1.0168
65.0	1.0056
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0787
95.0	1.2020
100.0	1.3394
105.0	1.4924
110.0	1.6630

EXHIBIT 2.58



MIN TEMP = 0.0
MAX TEMP = 110.00

N(LOW TEMP)	65	STD ERROR(LOW TEMP)	51.64%
N(FTP TEMP)	48	STD ERROR(FTP TEMP)	54.14%
N(HIGHTEMP)	12	STD ERROR(HIGHTEMP)	36.58%

EFFECT(LOW TEMP) = EXP(-0.011939(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(0.033678(TEMP-86.5))

EXHIBIT 2.59

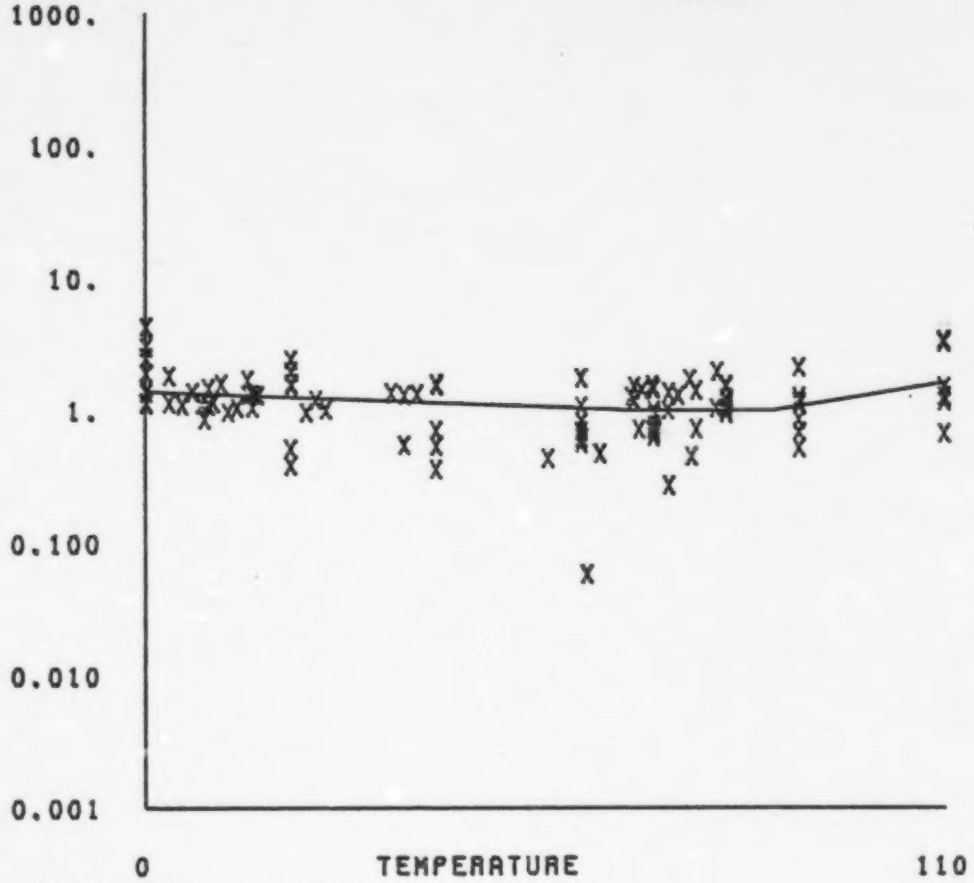
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 77FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.2386
5.0	2.1089
10.0	1.9867
15.0	1.8716
20.0	1.7631
25.0	1.6609
30.0	1.5647
35.0	1.4740
40.0	1.3886
45.0	1.3082
50.0	1.2324
55.0	1.1609
60.0	1.0937
65.0	1.0303
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1251
95.0	1.3314
100.0	1.5756
105.0	1.8646
110.0	2.2066

EXHIBIT 2.60

MYR=78; STDS=CAL
BAG2 HC



```
MIN TEMP =    -3.8
MAX TEMP = 110.00

N(LOW TEMP) 57             STD ERROR(LOW TEMP)     59.65%
N(FTP TEMP) 29             STD ERROR(FTP TEMP)     45.90%
N(HIGHTEMP) 13             STD ERROR(HIGHTEMP)     50.20%

     EFFECT(LOW TEMP) = EXP(-0.004721(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP( 0.020171(TEMP-86.5))
```

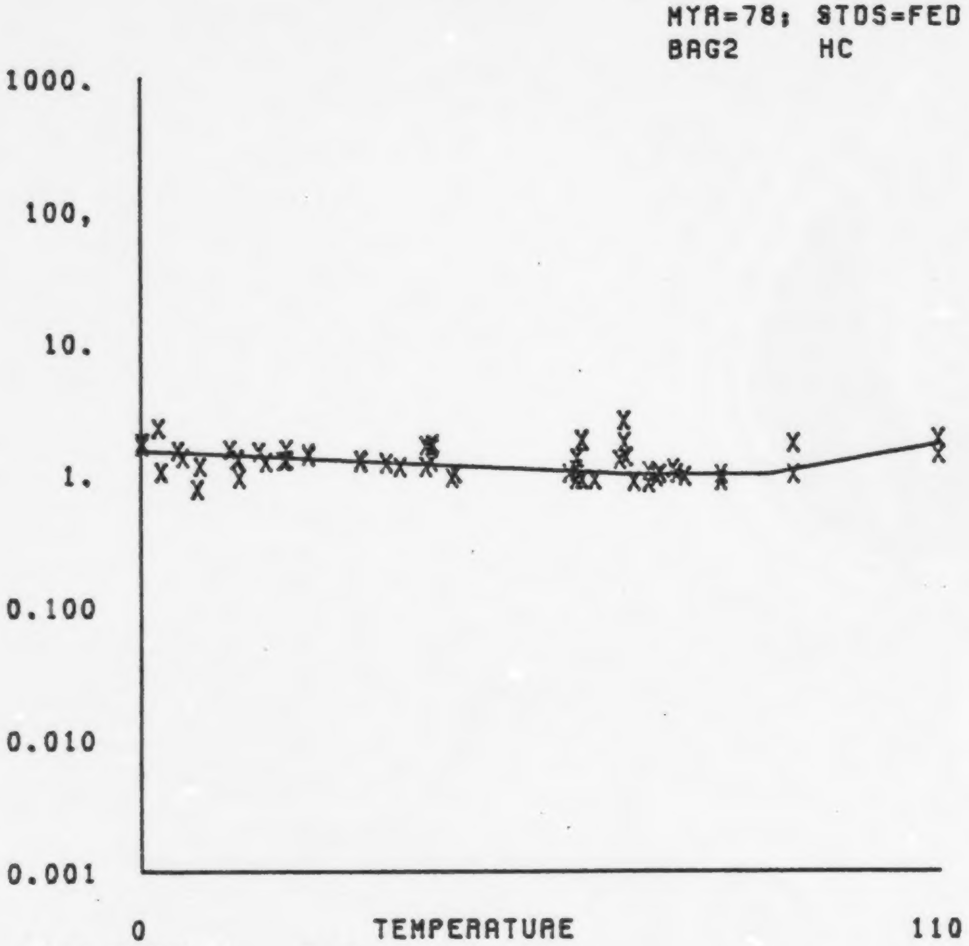
EXHIBIT 2.61

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 78CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.3753
5.0	1.3432
10.0	1.3119
15.0	1.2813
20.0	1.2514
25.0	1.2222
30.0	1.1937
35.0	1.1658
40.0	1.1386
45.0	1.1121
50.0	1.0861
55.0	1.0608
60.0	1.0360
65.0	1.0119
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0731
95.0	1.1870
100.0	1.3130
105.0	1.4523
110.0	1.6064

EXHIBIT 2.62



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 42             STD ERROR(LOW TEMP)    28.99%
N(FTP TEMP) 10             STD ERROR(FTP TEMP)    10.03%
N(HIGHTEMP) 4              STD ERROR(HIGHTEMP)    26.36%

     EFFECT(LOW TEMP)  = EXP(-0.006071(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.022296(TEMP-86.5))
```

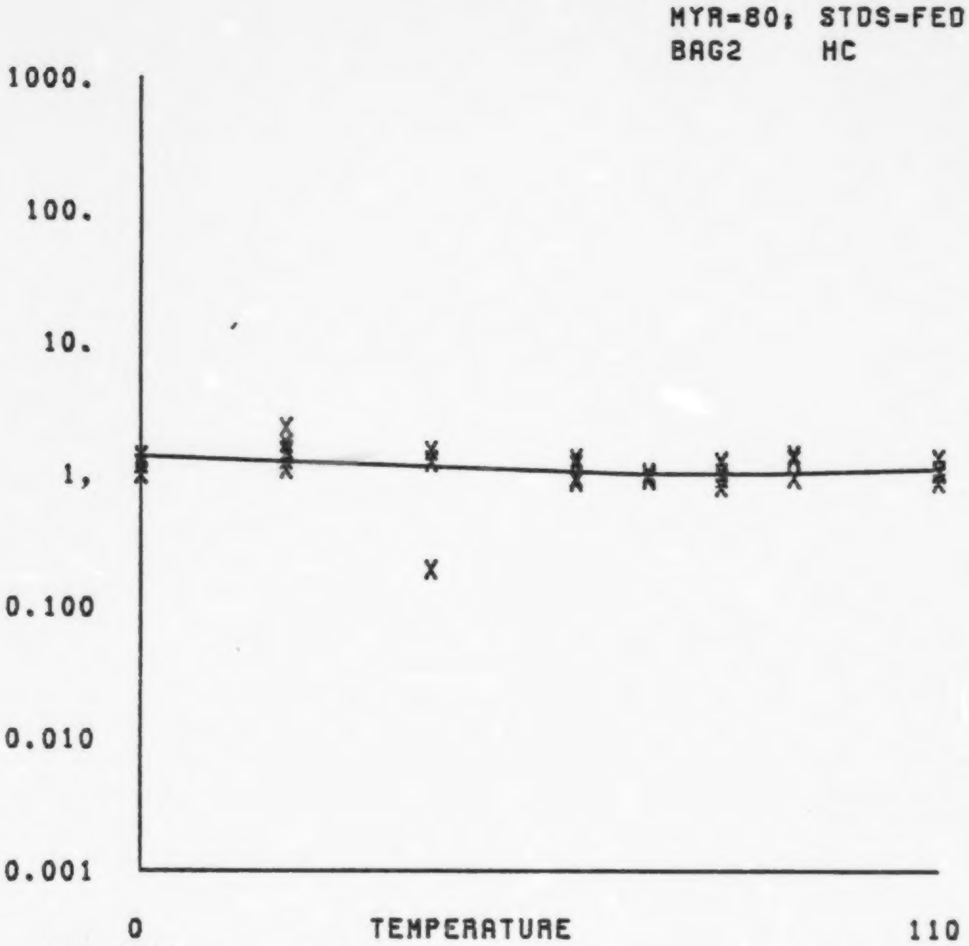
EXHIBIT 2.63

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC 78FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.5065
5.0	1.4615
10.0	1.4178
15.0	1.3754
20.0	1.3343
25.0	1.2944
30.0	1.2557
35.0	1.2181
40.0	1.1817
45.0	1.1464
50.0	1.1121
55.0	1.0788
60.0	1.0466
65.0	1.0153
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0812
95.0	1.2087
100.0	1.3512
105.0	1.5106
110.0	1.6887

EXHIBIT 2.64



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 17             STD ERROR(LOW TEMP)    49.06%
N(FTP TEMP) 11             STD ERROR(FTP TEMP)    14.05%
N(HIGHTEMP) 10             STD ERROR(HIGHTEMP)    16.93%

     EFFECT(LOW TEMP)  = EXP(-0.004417(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.003223(TEMP-86.5))
```

EXHIBIT 2.65

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF HC   80FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.3473
5.0	1.3179
10.0	1.2891
15.0	1.2610
20.0	1.2334
25.0	1.2065
30.0	1.1801
35.0	1.1543
40.0	1.1291
45.0	1.1045
50.0	1.0804
55.0	1.0568
60.0	1.0337
65.0	1.0111
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0113
95.0	1.0278
100.0	1.0445
105.0	1.0614
110.0	1.0787

EXHIBIT 2.66: FITTED TEMPERATURE EFFECTS, HC BAG3

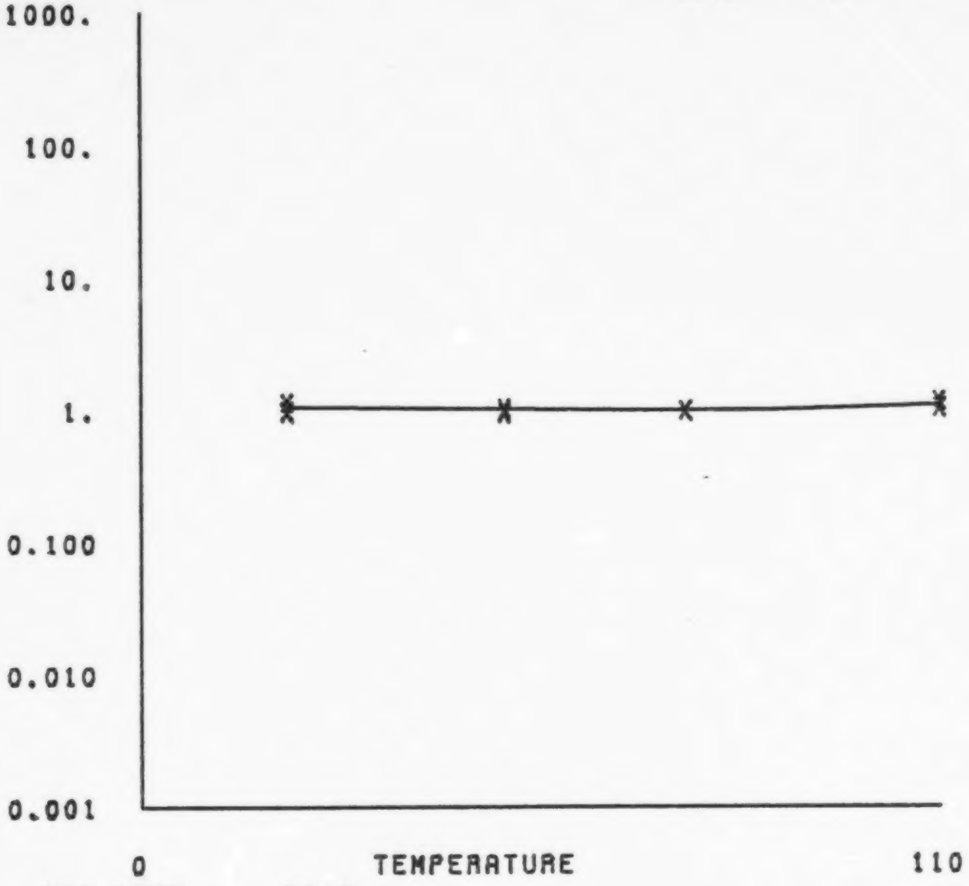
$$\frac{\text{EMISSIONS AT TEMPERATURE T}}{\text{EMISSIONS AT FTP TEMPERATURE}} = \begin{cases} \exp[c(T-67.5)] \text{ for T less than 67.5} \\ \exp[d(T-86.5)] \text{ for T greater than 86.5} \end{cases}$$

where exp is the exponential function and c and d are as tabled below.

MYR STDS	c	d
67FED	-.00100807	.00347991
69FED	-.00086884	.00758432
70FED	.00113998	.00961413
71FED	.00085607	.00686235
72FED	.00331824	.00984863
73FED	-.00088422	.01337504
74FED	.00865501	.01295946
75CAL	-.00127247	-.11430698
75FED	-.00524228	.02009737
76FED	.00583704	NO DATA
77CAL	.00714639	.01168086
77FED	.00068689	.02222113
78CAL	-.00179981	.01505819
78FED	-.00071991	.03866839
80FED	-.00848640	.01141540

EXHIBIT 2.67

MYR=67; STDS=FED
BAG3 HC



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 6                STD ERROR(LOW TEMP)     6.32%
N(FTP TEMP) 3                STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 3                STD ERROR(HIGHTEMP)     5.46%

     EFFECT(LOW TEMP)  = EXP(-0.001008(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.003480(TEMP-86.5))
```

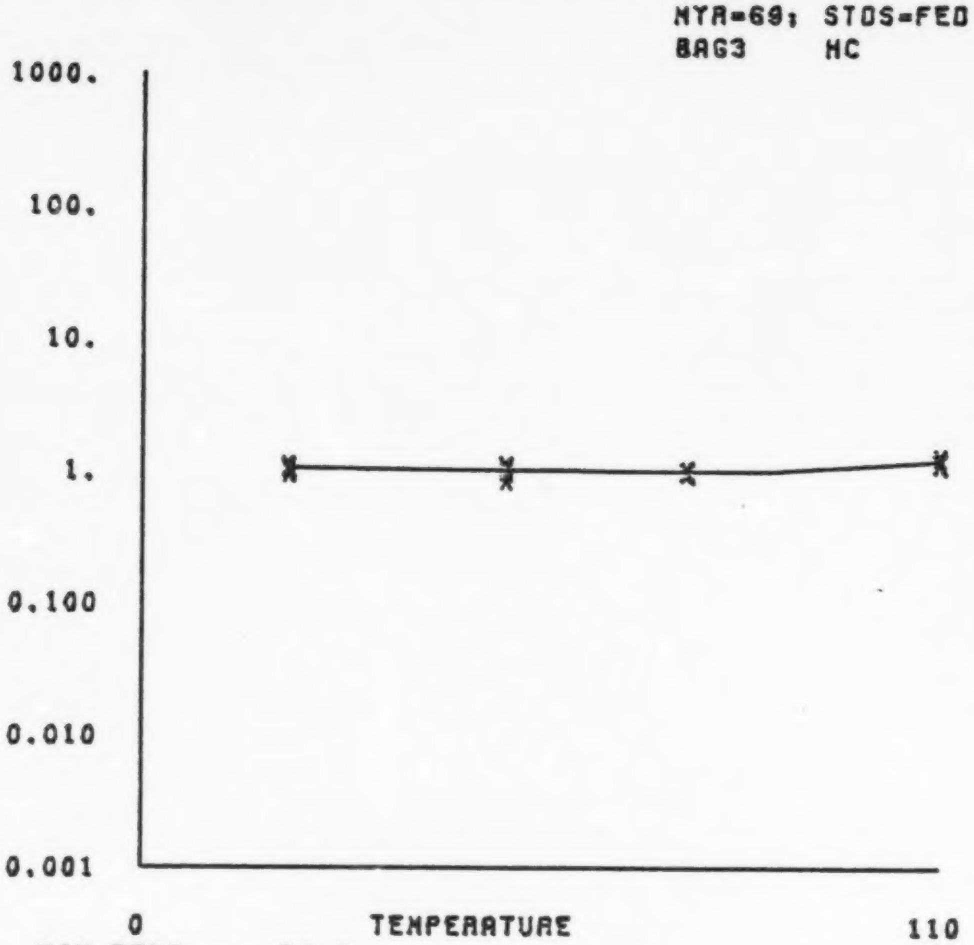
EXHIBIT 2.68

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC   67FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0704
5.0	1.0650
10.0	1.0597
15.0	1.0543
20.0	1.0490
25.0	1.0438
30.0	1.0385
35.0	1.0333
40.0	1.0281
45.0	1.0229
50.0	1.0178
55.0	1.0127
60.0	1.0076
65.0	1.0025
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0123
95.0	1.0300
100.0	1.0481
105.0	1.0665
110.0	1.0852

EXHIBIT 2.69



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 8                STD ERROR(LOW TEMP)     7.39%
N(FTP TEMP) 4                STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 4                STD ERROR(HIGHTEMP)     4.26%

     EFFECT(LOW TEMP)  = EXP(-0.000869(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.007584(TEMP-86.5))
```

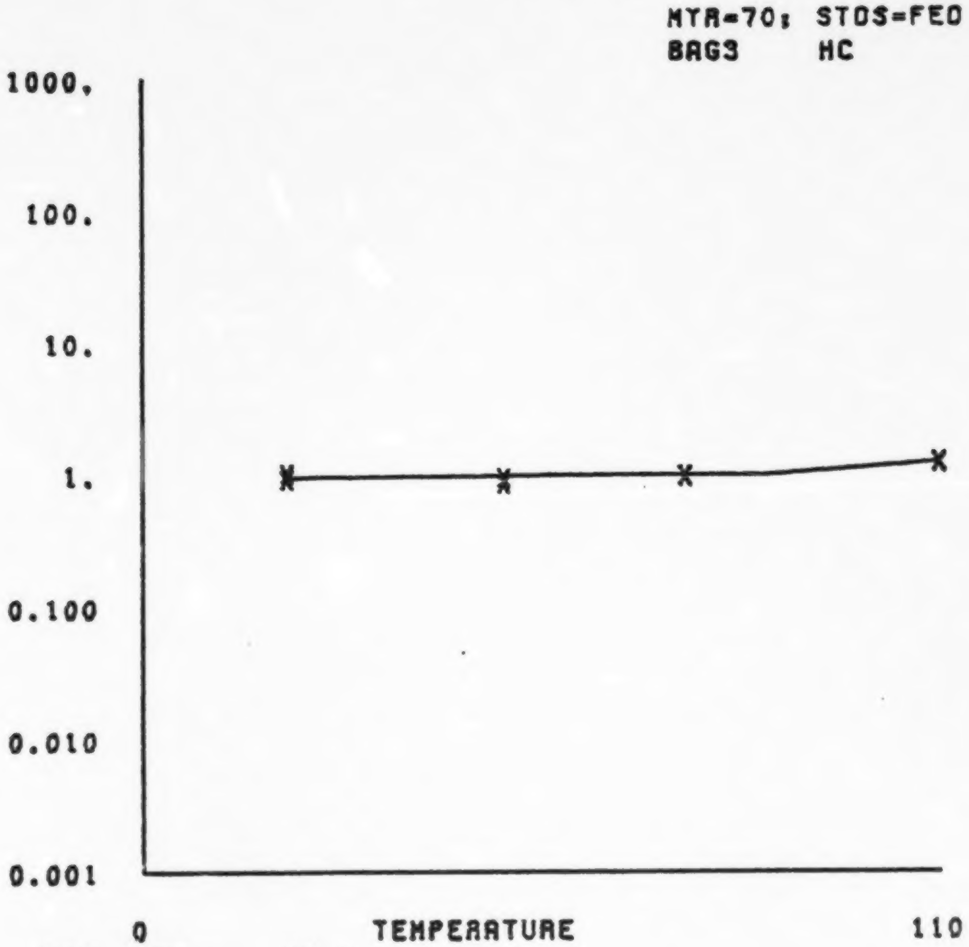
EXHIBIT 2.70

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC   69FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0604
5.0	1.0558
10.0	1.0512
15.0	1.0467
20.0	1.0421
25.0	1.0376
30.0	1.0331
35.0	1.0286
40.0	1.0242
45.0	1.0197
50.0	1.0153
55.0	1.0109
60.0	1.0065
65.0	1.0022
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0269
95.0	1.0666
100.0	1.1078
105.0	1.1506
110.0	1.1951

EXHIBIT 2.71



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 4            STD ERROR(LOW TEMP)     7.94%
N(FTP TEMP) 2            STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 2            STD ERROR(HIGHTEMP)     0.88%

     EFFECT(LOW TEMP)  = EXP( 0.001140(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.009614(TEMP-86.5))
```

EXHIBIT 2.72

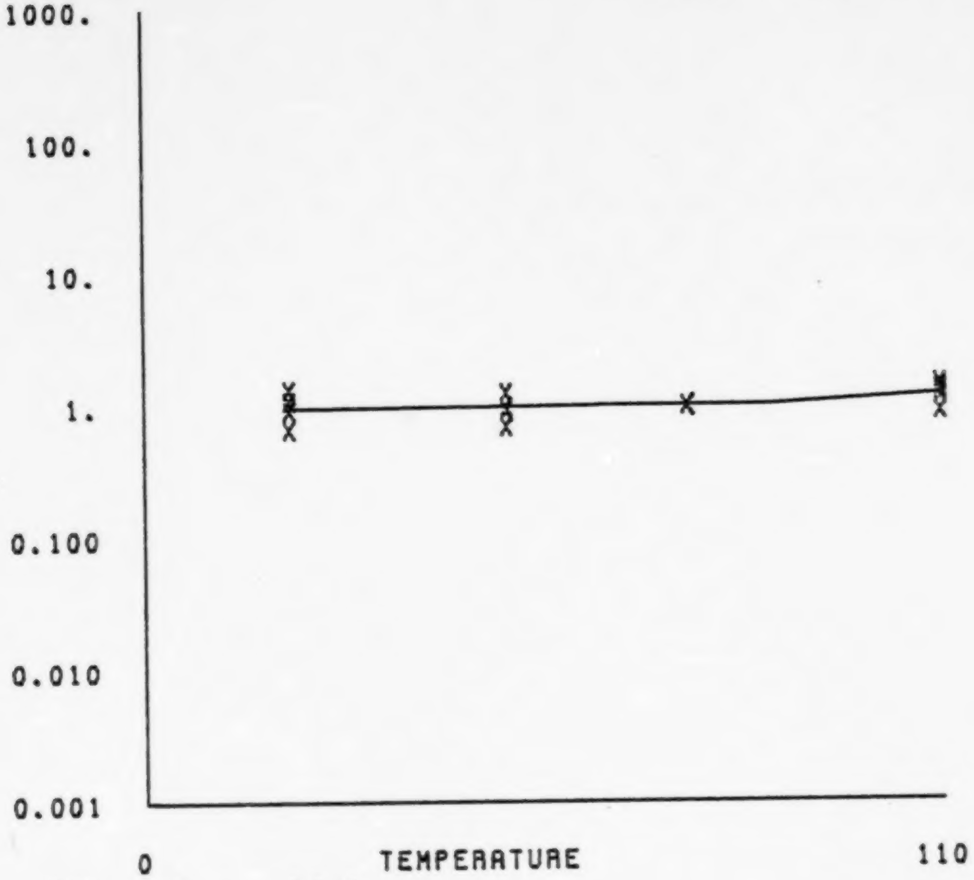
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC 70FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9259
5.0	0.9312
10.0	0.9366
15.0	0.9419
20.0	0.9473
25.0	0.9527
30.0	0.9582
35.0	0.9636
40.0	0.9691
45.0	0.9747
50.0	0.9802
55.0	0.9859
60.0	0.9915
65.0	0.9972
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0342
95.0	1.0852
100.0	1.1386
105.0	1.1947
110.0	1.2535

EXHIBIT 2.73

MYR=71; STDS=FED
BAG3   HC



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 10            STD ERROR(LOW TEMP)    21.07%
N(FTP TEMP) 5             STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 5             STD ERROR(HIGHTEMP)    16.31%

    EFFECT(LOW TEMP) = EXP( 0.000856(TEMP-67.5))
    EFFECT(HIGHTEMP) = EXP( 0.006862(TEMP-86.5))
```

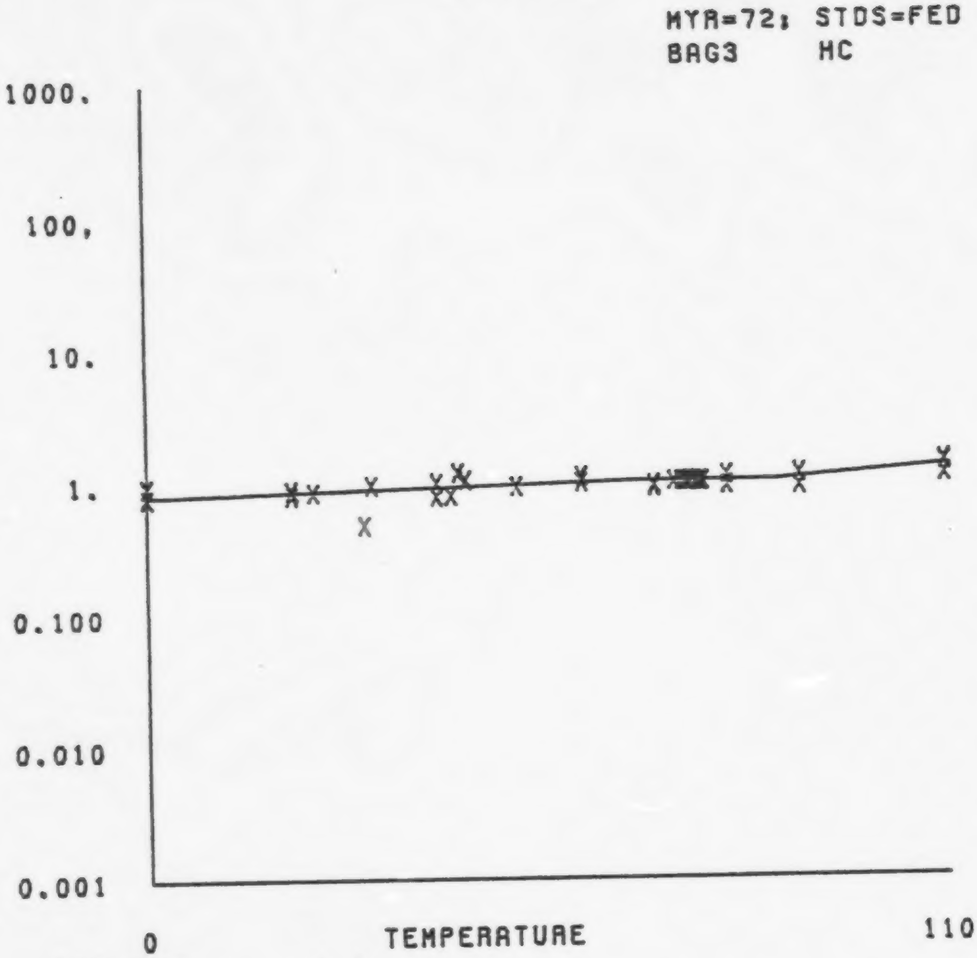
EXHIBIT 2.74

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC 71FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9439
5.0	0.9479
10.0	0.9520
15.0	0.9561
20.0	0.9602
25.0	0.9643
30.0	0.9684
35.0	0.9726
40.0	0.9767
45.0	0.9809
50.0	0.9851
55.0	0.9894
60.0	0.9936
65.0	0.9979
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0243
95.0	1.0601
100.0	1.0971
105.0	1.1354
110.0	1.1750

EXHIBIT 2.75



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 16                STD ERROR(LOW TEMP)    18.59%
N(FTP TEMP) 12                STD ERROR(FTP TEMP)     9.76%
N(HIGHTEMP) 5                 STD ERROR(HIGHTEMP)    10.69%

     EFFECT(LOW TEMP) = EXP( 0.003318(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP( 0.009849(TEMP-86.5))
```

EXHIBIT 2.76

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC 72FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.7993
5.0	0.8127
10.0	0.8263
15.0	0.8401
20.0	0.8542
25.0	0.8685
30.0	0.8830
35.0	0.8978
40.0	0.9128
45.0	0.9281
50.0	0.9436
55.0	0.9594
60.0	0.9754
65.0	0.9917
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0351
95.0	1.0873
100.0	1.1422
105.0	1.1999
110.0	1.2604

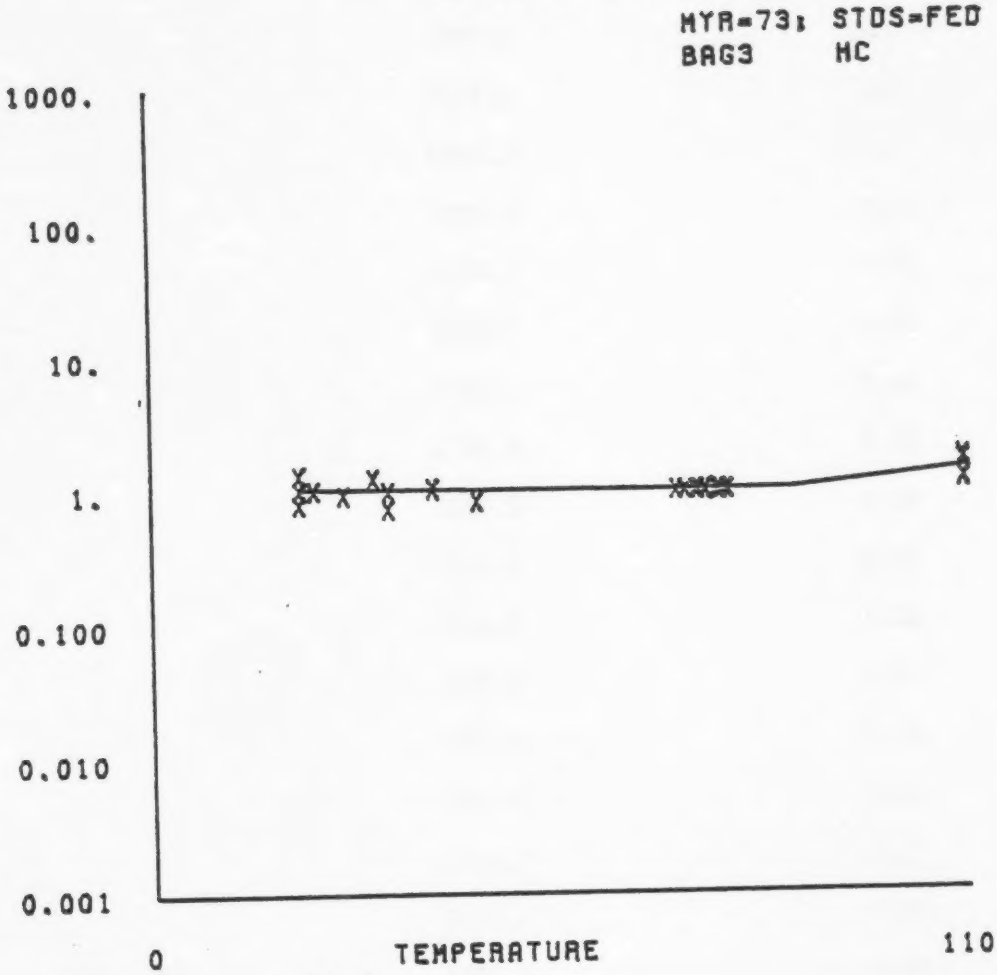
EXHIBIT 2.78

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC 73FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0615
5.0	1.0568
10.0	1.0522
15.0	1.0475
20.0	1.0429
25.0	1.0383
30.0	1.0337
35.0	1.0292
40.0	1.0246
45.0	1.0201
50.0	1.0156
55.0	1.0111
60.0	1.0067
65.0	1.0022
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0479
95.0	1.1204
100.0	1.1979
105.0	1.2807
110.0	1.3693

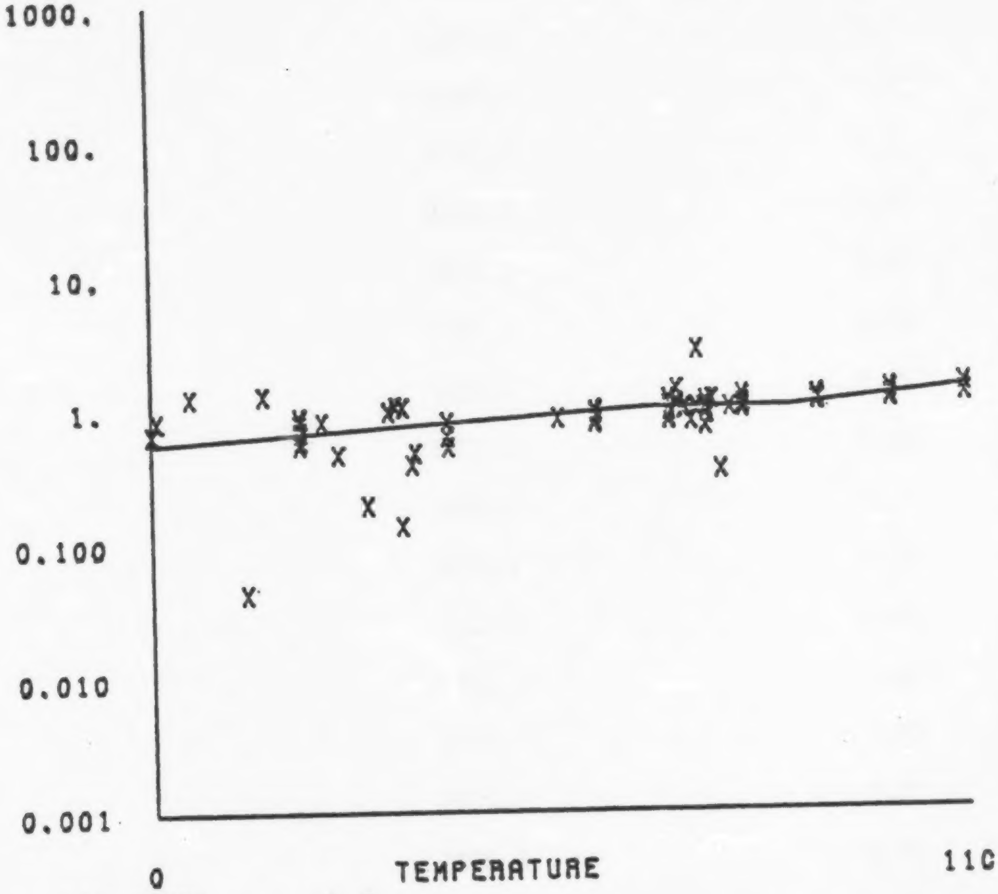
EXHIBIT 2.77



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP)  12                STD ERROR(LOW TEMP)    17.70%
N(FTP TEMP)  12                STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP)  4                 STD ERROR(HIGHTEMP)    17.18%

     EFFECT(LOW TEMP)  = EXP(-0.000884(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.013375(TEMP-86.5))
```

EXHIBIT 2.79

MYR=74; STDS=FED
BAG3 HC



```
MIN TEMP =    -6.9
MAX TEMP = 110.00

N(LOW TEMP) 35            STD ERROR(LOW TEMP)    67.31%
N(FTP TEMP) 29            STD ERROR(FTP TEMP)    40.26%
N(HIGHTEMP) 12            STD ERROR(HIGHTEMP)     9.17%

     EFFECT(LOW TEMP)  = EXP( 0.008655(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.012959(TEMP-86.5))
```

EXHIBIT 2.80

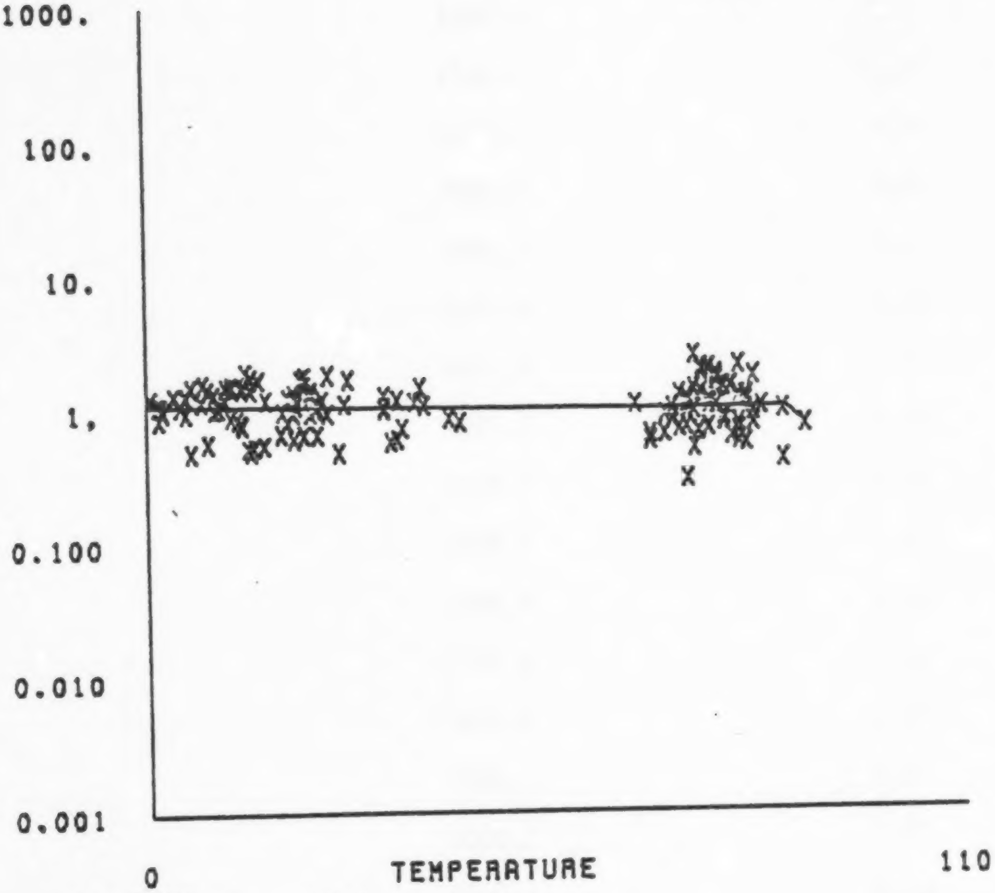
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC 74FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.5575
5.0	0.5822
10.0	0.6079
15.0	0.6348
20.0	0.6629
25.0	0.6922
30.0	0.7228
35.0	0.7548
40.0	0.7882
45.0	0.8231
50.0	0.8594
55.0	0.8975
60.0	0.9371
65.0	0.9786
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0464
95.0	1.1165
100.0	1.1912
105.0	1.2709
110.0	1.3560

EXHIBIT 2.81

MYR=75; STDS=CAL
BAG3 HC



```
MIN TEMP =   -7.1
MAX TEMP =  89.00

N(LOW TEMP) 90                  STD ERROR(LOW TEMP)    35.98%
N(FTP TEMP) 53                  STD ERROR(FTP TEMP)    44.14%
N(HIGHTEMP) 1                   STD ERROR(HIGHTEMP)     0.0 %

      EFFECT(LOW TEMP)  = EXP(-0.001272(TEMP-67.5))
      EFFECT(HIGHTEMP)  = EXP(-0.114307(TEMP-86.5))
```

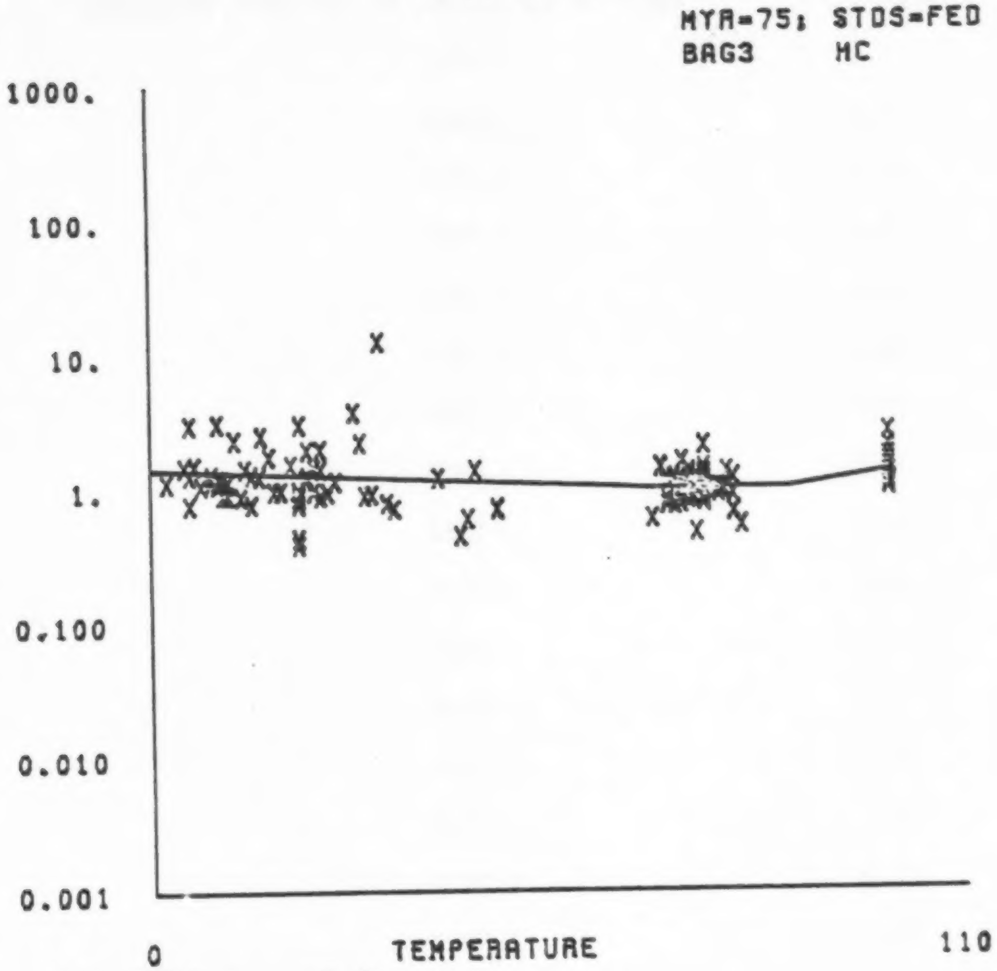
EXHIBIT 2.82

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC 75CAL

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0897
5.0	1.0828
10.0	1.0759
15.0	1.0691
20.0	1.0623
25.0	1.0556
30.0	1.0489
35.0	1.0422
40.0	1.0356
45.0	1.0290
50.0	1.0225
55.0	1.0160
60.0	1.0096
65.0	1.0032
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.6703
95.0	0.3785
100.0	0.2137
105.0	0.1207
110.0	0.0681

EXHIBIT 2.83



MIN TEMP = -5.8
MAX TEMP = 100.00

N(LOW TEMP)	70	STD ERROR(LOW TEMP)	55.70%
N(FTP TEMP)	62	STD ERROR(FTP TEMP)	33.57%
N(HIGHTEMP)	11	STD ERROR(HIGHTEMP)	30.55%

EFFECT(LOW TEMP) = EXP(-0.005242(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(0.020097(TEMP-86.5))

EXHIBIT 2.84

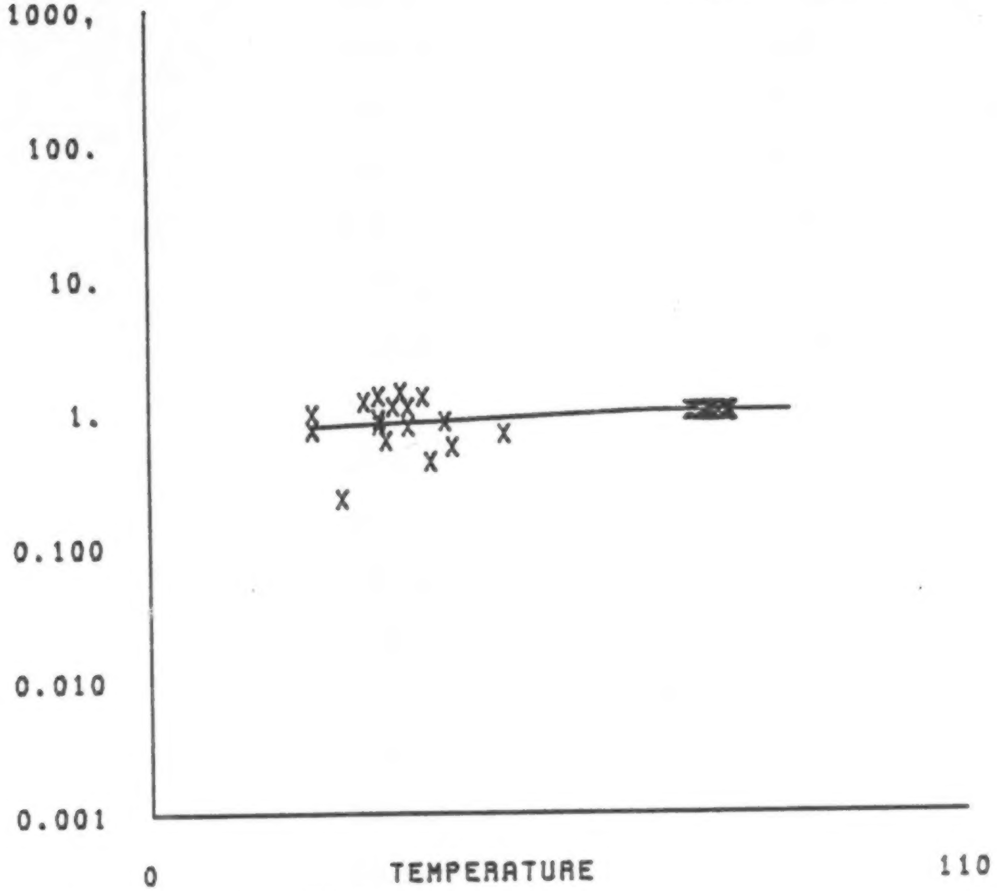
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC 75FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.4245
5.0	1.3877
10.0	1.3518
15.0	1.3168
20.0	1.2828
25.0	1.2496
30.0	1.2172
35.0	1.1857
40.0	1.1551
45.0	1.1252
50.0	1.0961
55.0	1.0677
60.0	1.0401
65.0	1.0132
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0729
95.0	1.1863
100.0	1.3117
105.0	1.4503
110.0	1.6037

EXHIBIT 2.85

MYR=78; STDS=FED
BAG3 HC



MIN TEMP = 22.0
MAX TEMP = 78.70

N (LOW TEMP)	19	STD ERROR (LOW TEMP)	42.61%
N (FTP TEMP)	19	STD ERROR (FTP TEMP)	0.0 %
N (HIGHTEMP)	0	STD ERROR (HIGHTEMP)	0.0 %

EFFECT (LOW TEMP) = EXP(0.005837 (TEMP-67.5))

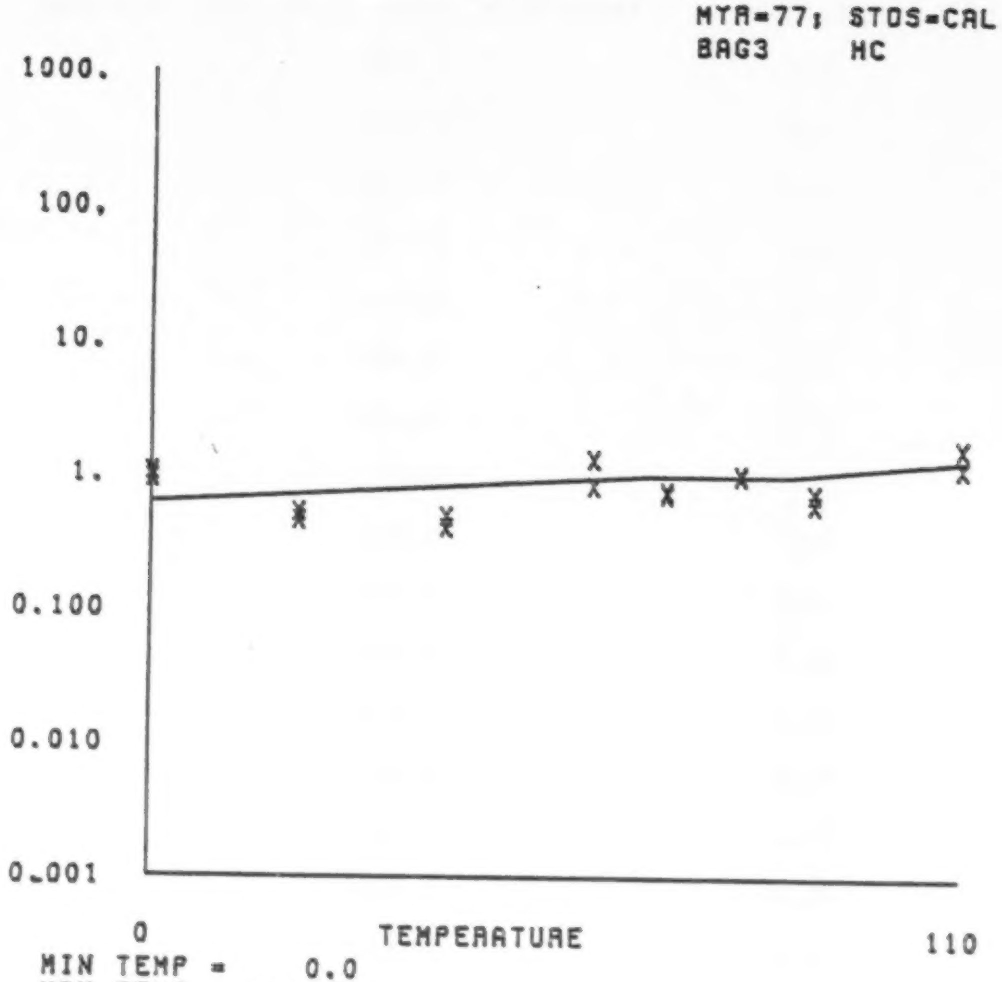
EXHIBIT 2.86

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC 76FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.6744
5.0	0.6943
10.0	0.7149
15.0	0.7361
20.0	0.7579
25.0	0.7803
30.0	0.8034
35.0	0.8272
40.0	0.8517
45.0	0.8769
50.0	0.9029
55.0	0.9296
60.0	0.9572
65.0	0.9855
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	No data
95.0	" "
100.0	" "
105.0	" "
110.0	" "

EXHIBIT 2.87



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 8              STD ERROR(LOW TEMP)    44.41%
N(FTP TEMP) 4              STD ERROR(FTP TEMP)    22.40%
N(HIGHTEMP) 4              STD ERROR(HIGHTEMP)    32.93%

     EFFECT(LOW TEMP)  = EXP( 0.007146(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.011681(TEMP-86.5))
```

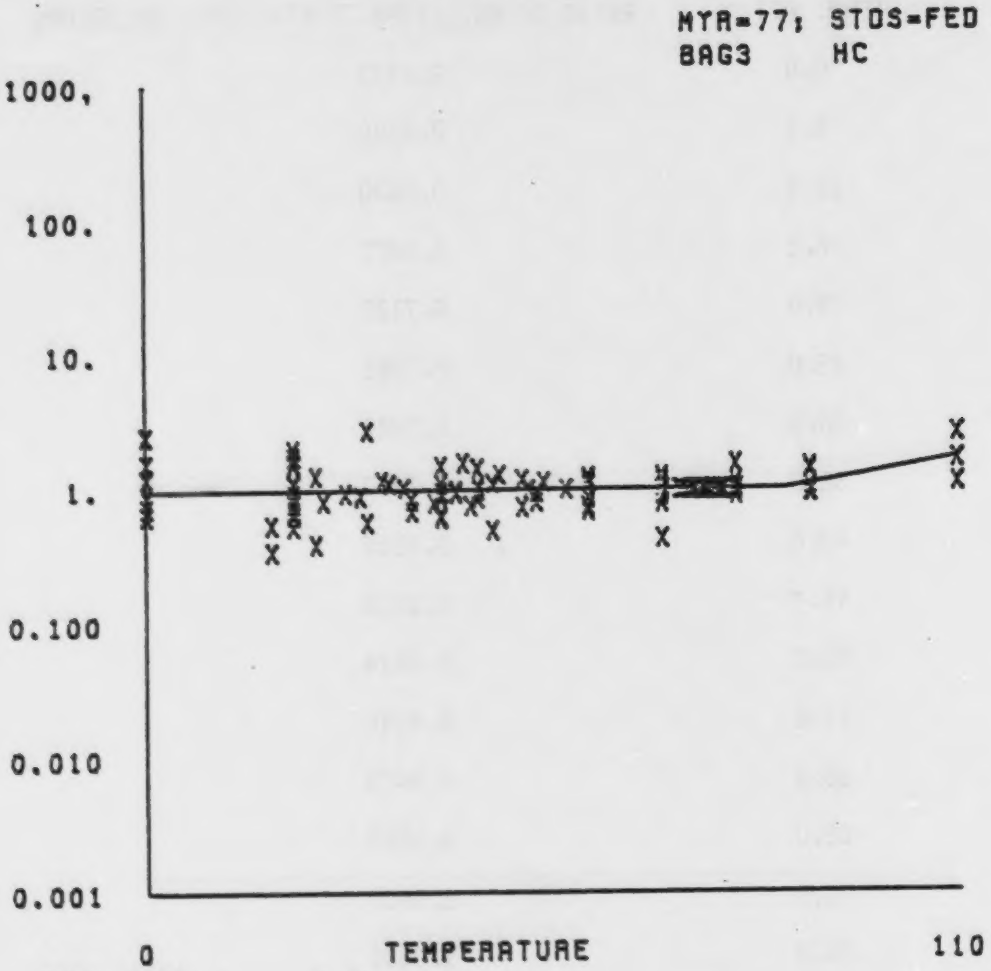
EXHIBIT 2.88

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC   77CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.6173
5.0	0.6398
10.0	0.6630
15.0	0.6872
20.0	0.7122
25.0	0.7381
30.0	0.7649
35.0	0.7927
40.0	0.8216
45.0	0.8515
50.0	0.8824
55.0	0.9145
60.0	0.9478
65.0	0.9823
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0417
95.0	1.1044
100.0	1.1708
105.0	1.2412
110.0	1.3159

EXHIBIT 2.89



```
MIN TEMP =     0.0
MAX TEMP = 110.00

N(LOW TEMP) 65          STD ERROR(LOW TEMP)    38.54%
N(FTP TEMP) 48          STD ERROR(FTP TEMP)    32.99%
N(HIGHTEMP) 12          STD ERROR(HIGHTEMP)    27.84%

    EFFECT(LOW TEMP)  = EXP( 0.000687(TEMP-67.5))
    EFFECT(HIGHTEMP)  = EXP( 0.022221(TEMP-86.5))
```

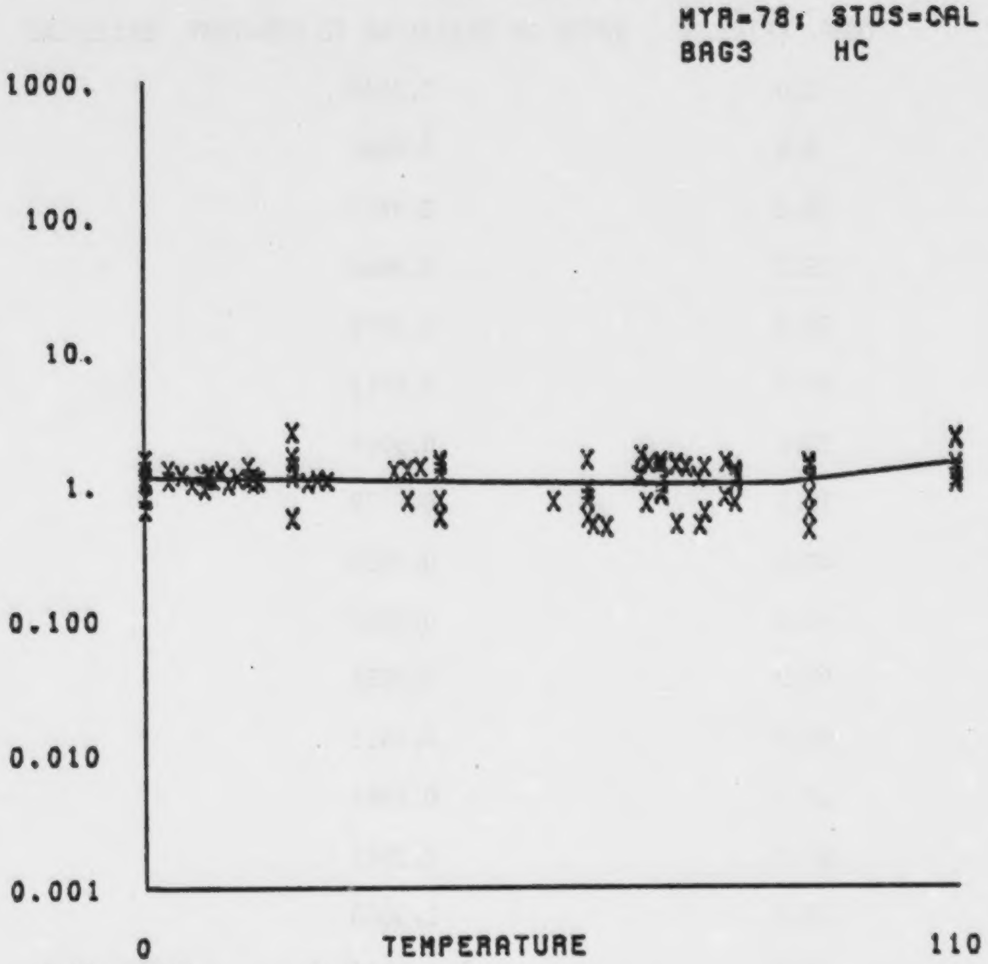
EXHIBIT 2.90

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC 77FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9547
5.0	0.9580
10.0	0.9613
15.0	0.9646
20.0	0.9679
25.0	0.9712
30.0	0.9746
35.0	0.9779
40.0	0.9813
45.0	0.9847
50.0	0.9881
55.0	0.9915
60.0	0.9949
65.0	0.9983
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0809
95.0	1.2079
100.0	1.3498
105.0	1.5085
110.0	1.6857

EXHIBIT 2.91



```
MIN TEMP =    -3.8
MAX TEMP = 110.00

N(LOW TEMP) 57               STD ERROR(LOW TEMP)    32.25%
N(FTP TEMP) 29               STD ERROR(FTP TEMP)    33.14%
N(HIGHTEMP) 13               STD ERROR(HIGHTEMP)    37.90%

     EFFECT(LOW TEMP)  = EXP(-0.001800(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.015058(TEMP-86.5))
```

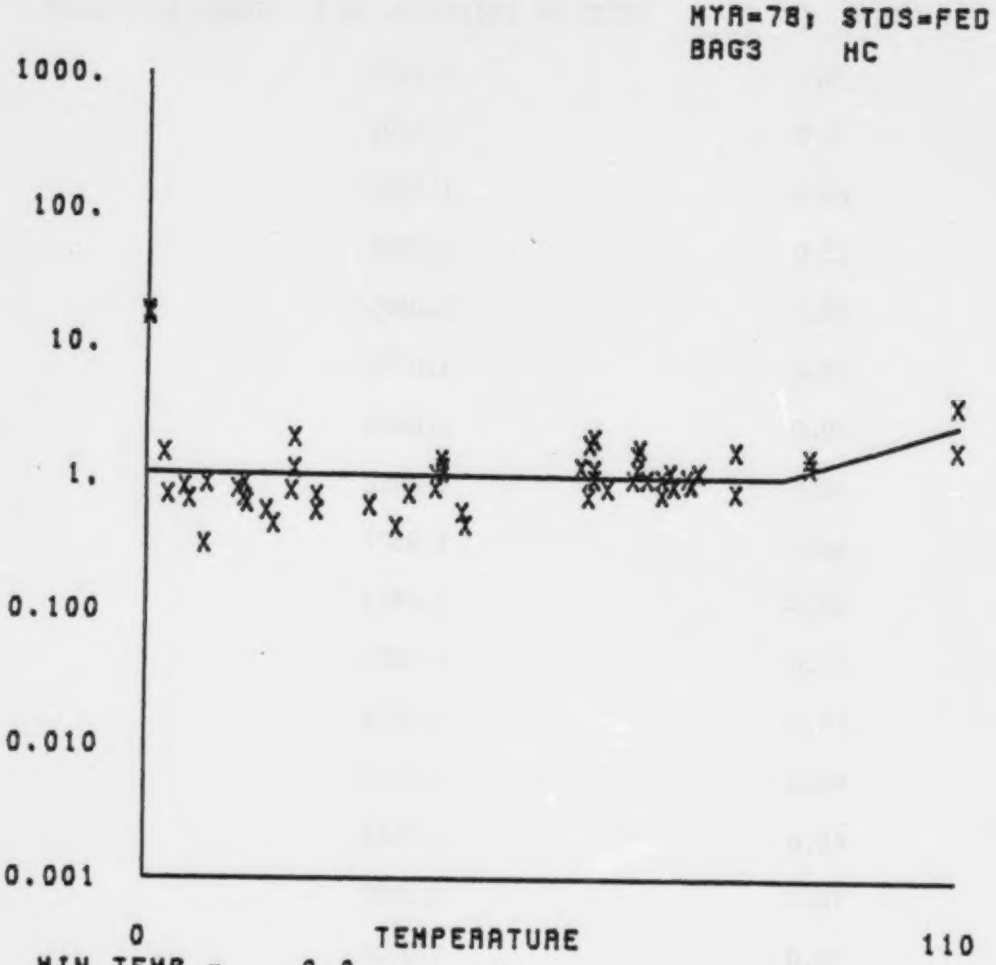
EXHIBIT 2.92

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC   78CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.1292
5.0	1.1191
10.0	1.1090
15.0	1.0991
20.0	1.0893
25.0	1.0795
30.0	1.0698
35.0	1.0602
40.0	1.0507
45.0	1.0413
50.0	1.0320
55.0	1.0228
60.0	1.0136
65.0	1.0045
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0541
95.0	1.1365
100.0	1.2254
105.0	1.3212
110.0	1.4246

EXHIBIT 2.93



MIN TEMP = 0.0
MAX TEMP = 110.00

N (LOW TEMP) 42
N (FTP TEMP) 10
N (HIGHTEMP) 4

STD ERROR (LOW TEMP) 75.12%
STD ERROR (FTP TEMP) 25.91%
STD ERROR (HIGHTEMP) 29.72%

EFFECT (LOW TEMP) = EXP (-0.000720 (TEMP-67.5))
EFFECT (HIGHTEMP) = EXP (0.038688 (TEMP-86.5))

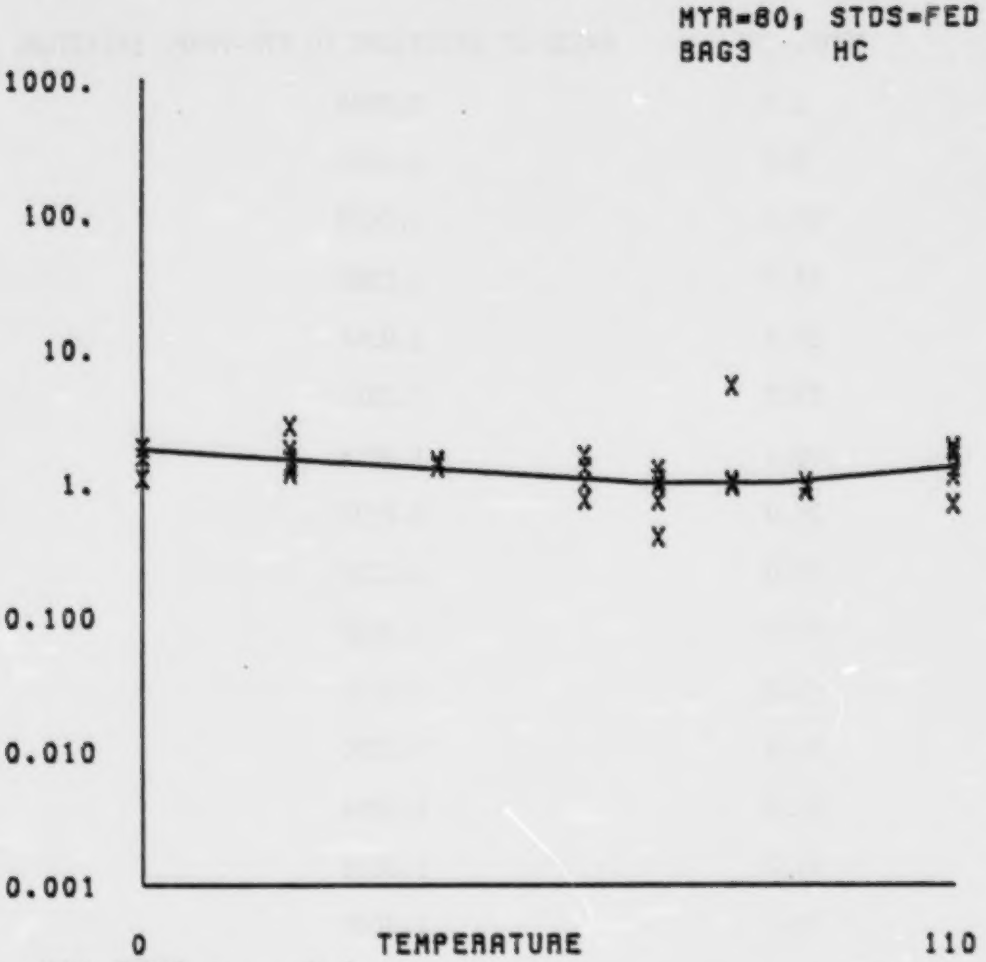
EXHIBIT 2.94

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC 78FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0498
5.0	1.0460
10.0	1.0423
15.0	1.0385
20.0	1.0348
25.0	1.0311
30.0	1.0274
35.0	1.0237
40.0	1.0200
45.0	1.0163
50.0	1.0127
55.0	1.0090
60.0	1.0054
65.0	1.0018
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1449
95.0	1.3891
100.0	1.6854
105.0	2.0449
110.0	2.4811

EXHIBIT 2.95



MIN TEMP = 0.0
MAX TEMP = 110.00

N(LOW TEMP) 17
N(FTP TEMP) 11
N(HIGHTEMP) 10

STD ERROR(LOW TEMP) 25.27%
STD ERROR(FTP TEMP) 89.01%
STD ERROR(HIGHTEMP) 27.16%

EFFECT(LOW TEMP) = EXP(-0.008486(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(0.011415(TEMP-86.5))

EXHIBIT 2.96

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF HC 80FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.7733
5.0	1.6996
10.0	1.6290
15.0	1.5613
20.0	1.4965
25.0	1.4343
30.0	1.3747
35.0	1.3176
40.0	1.2629
45.0	1.2104
50.0	1.1601
55.0	1.1119
60.0	1.0657
65.0	1.0214
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0408
95.0	1.1019
100.0	1.1666
105.0	1.2351
110.0	1.3077

3.0 THE EFFECT OF TEMPERATURE ON CARBON MONOXIDE EMISSIONS

Measurements of CO emissions of more than 100 vehicles at various temperatures were available in the data sources described in appendix B. Because the desired form of the ultimate correction formulae for emissions concerned ratios of emissions at various temperatures, the first step in the analysis of the data was to take logarithms of all emissions data[1]. Since it was desired to separate the effects of temperature on emissions from any confounding effect related to the fact that vehicles had significantly different absolute emission levels, the second step in the preparation of the data for analysis was the reduction of the original emissions data, given in measured grams per mile of emissions for each of the three bags of the Federal Test Procedure, to temperature effect data. To do this, the mean log emissions of each vehicle at FTP temperature were estimated by the mean of the relevant measured emissions. This estimate of the FTP-temperature log emissions was then subtracted from each test measurement in the data for this vehicle to derive logarithmic temperature effect data for each test. Each such datum is essentially an estimate of the logarithm of the ratio of the emissions under the actual test conditions to those under FTP temperature conditions.

---

[1] In some of the data sets, mileage adjustments were made before this step, as described in appendix B.

3.1 THE EXISTENCE AND NATURE OF TEMPERATURE EFFECTS

Prior to fitting explicit temperature-dependency formulae, the data for each FTP bag was examined to determine whether temperature effects existed. To do this, the data was divided into three groups, one representing measurements at temperatures below the FTP range, one representing measurements in the FTP range, and one representing measurements at temperatures above the FTP temperature range. If no temperature effect was present, the distribution of the measured temperature effect in each of the low-temperature and high-temperature groups could reasonably be expected to be identical, and to have mean and median zero or very nearly zero. Exhibits 3.1 through 3.3 show the actual mean, standard deviation, minimum, quartiles, and maximum of the data in each of the two temperature groups for each of the three bags.

Inspection of the data indicates the presence of apparent temperature effects in all bags. To confirm this impression, formal statistical tests were applied to verify the presence of temperature effects in all three bags. Kolmogorov-Smirnov tests were used to test whether the high-temperature and low-temperature groups had statistically significantly different distributions. In all three bags, the distributions were found to be significantly different (at better than the .001 level), confirming the existence of temperature effects in all bags. As described in appendix A, all of the

EXHIBIT 3.1: BAG 1 CO TEMPERATURE EFFECTS

	LOW TEMP.	HIGH TEMP.
MEAN TEMPERATURE EFFECT	.75093	-.25380
STANDARD DEVIATION	.56623	.52966
MINIMUM TEMPERATURE EFFECT	-.54301	-1.9530
FIRST QUARTILE	.35383	-.56644
MEDIAN	.67529	-.19255
THIRD QUARTILE	1.0094	.08566
MAXIMUM TEMPERATURE EFFECT	3.1268	1.4101
NUMBER OF MEASUREMENTS	437	137

EXHIBIT 3.2: BAG 2 CO TEMPERATURE EFFECTS

	LOW TEMP.	HIGH TEMP.
MEAN TEMPERATURE EFFECT	.10307	.64967
STANDARD DEVIATION	.93038	.82092
MINIMUM TEMPERATURE EFFECT	-4.2649	-1.2969
FIRST QUARTILE	-.27240	.12025
MEDIAN	.05501	.50612
THIRD QUARTILE	.39599	.99739
MAXIMUM TEMPERATURE EFFECT	6.6592	4.3562
NUMBER OF MEASUREMENTS	387	137

EXHIBIT 3.3: BAG 3 CO TEMPERATURE EFFECTS

	LOW TEMP.	HIGH TEMP.
MEAN TEMPERATURE EFFECT	-.00150	.59795
STANDARD DEVIATION	.65062	.60218
MINIMUM TEMPERATURE EFFECT	-3.7004	-1.0858
FIRST QUARTILE	-.29566	.17524
MEDIAN	-.03409	.56798
THIRD QUARTILE	.28793	.95346
MAXIMUM TEMPERATURE EFFECT	4.9189	2.9427
NUMBER OF MEASUREMENTS	420	137

statistical tests used were non-parametric, so that no assumptions were required concerning the actual distribution of the measured temperature effects. On the basis of this analysis, it was found necessary to fit temperature effects equations to each of the three bags. From the data, it was expected that the equations would show increases in emissions at low temperatures for bags one and two, with little or no effect for bag three at low temperatures, and decreases in emissions at high temperatures for bag one, with increases at high temperatures for bags two and three.

3.2 EQUATIONS DESCRIBING TEMPERATURE DEPENDENCE

As described in appendix A, the data was found to show not only temperature effects, but also effects of model year and type of standards (California or 49-state Federal standards). As noted there, the data also showed an effect due to data source, but examination proved that the effects of model year and standards on temperature dependence remained even after allowance for the data source effect. Accordingly, separate fits were made for each model-year-standards combination in the data. As described in appendix A, the fits were made by least-squares methods to separate linear forms (in the temperature effects data - equivalent to exponential forms in actual emissions) for the low-temperature and high-temperature ranges. As with the case of HC emissions, the individual standards-year fits for CO generally bore out the results expected on the basis of the overall data.

These fitted equations, together with the data to which they were fitted, are shown in semi-log scale plots and tabular form in exhibits 3.04 through 3.96. The plots also give the minimum and maximum temperatures at which measurements were actually available for the various model-year-standards combinations. Data points for measurements below 0° are omitted from the plots. The tables give the values of the temperature effect equations at 5° intervals from 0° to 110°.

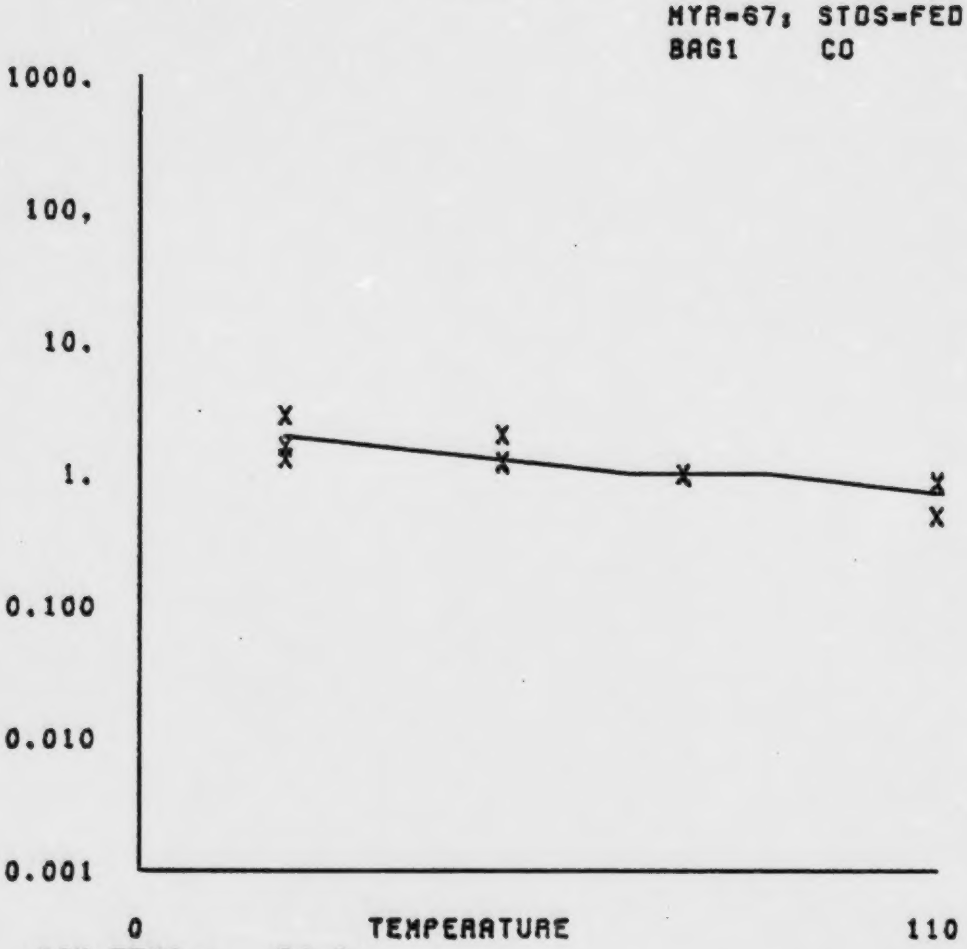
EXHIBIT 3.04: FITTED TEMPERATURE EFFECTS, CO BAG1

$$\frac{\text{EMISSIONS AT TEMPERATURE T}}{\text{EMISSIONS AT FTP TEMPERATURE}} = \begin{cases} \exp[c(T-67.5)] & \text{for T less than 67.5} \\ \exp[d(T-86.5)] & \text{for T greater than 86.5} \end{cases}$$

where exp is the exponential function and c and d are as tabled below.

MYR STDS	c	d
67FED	-.01348717	-.01469133
69FED	-.02112625	-.03876699
70FED	-.01036892	-.01197969
71FED	-.02356519	-.02547460
72FED	-.01786790	-.00562646
73FED	-.02131897	-.00527541
74FED	-.01864975	-.01997451
75CAL	-.01083444	-.17353164
75FED	-.01971154	-.02340391
76FED	-.03331773	NO DATA
77CAL	-.02135259	.02080920
77FED	-.03007814	-.01931160
78CAL	-.01244236	-.01402813
78FED	-.01358577	-.01088535
80FED	-.02022814	-.00961119

EXHIBIT 3.05



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 8              STD ERROR(LOW TEMP)    29.17%
N(FTP TEMP) 3              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 3              STD ERROR(HIGHTEMP)    27.22%

     EFFECT(LOW TEMP)  = EXP(-0.013487(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.014691(TEMP- 86.5) )
```

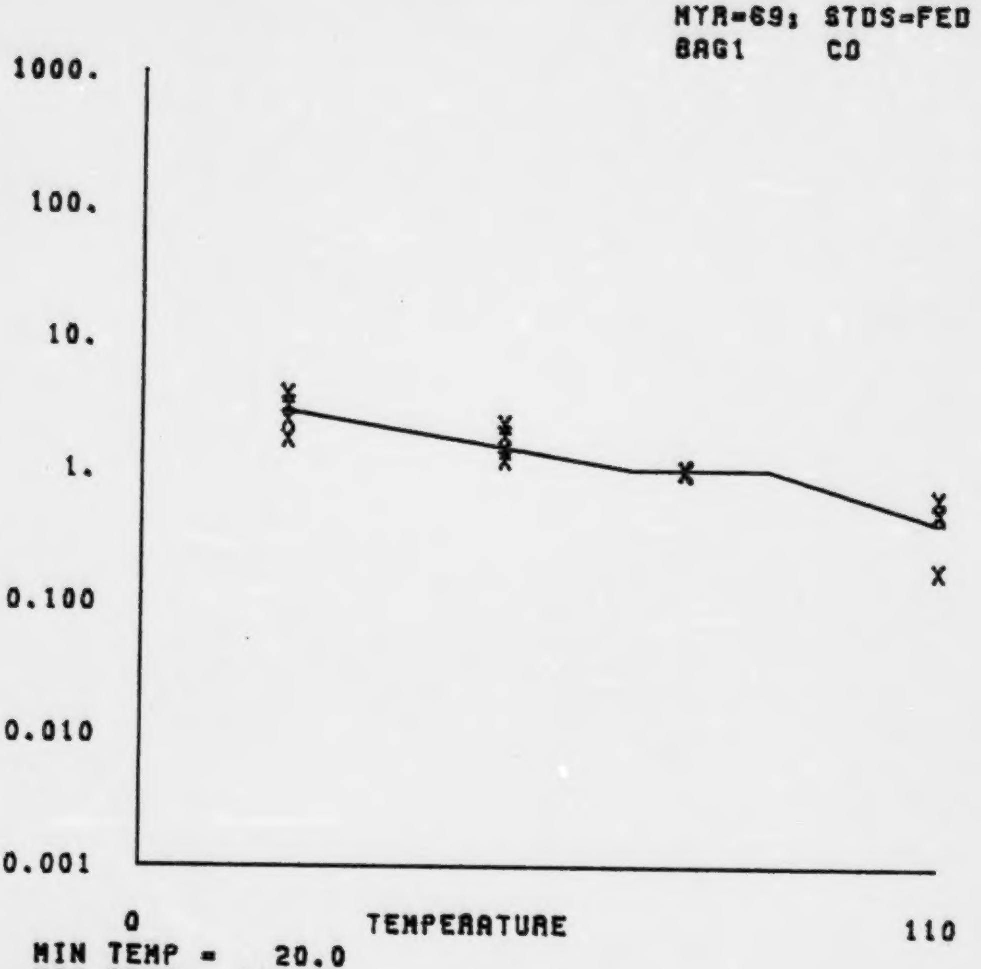
EXHIBIT 3.06

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO 67FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.4853
5.0	2.3232
10.0	2.1717
15.0	2.0301
20.0	1.8977
25.0	1.7739
30.0	1.6583
35.0	1.5501
40.0	1.4490
45.0	1.3545
50.0	1.2662
55.0	1.1836
60.0	1.1064
65.0	1.0343
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9499
95.0	0.8826
100.0	0.8201
105.0	0.7620
110.0	0.7080

EXHIBIT 3.07



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 8               STD ERROR(LOW TEMP)    27.76%
N(FTP TEMP) 4               STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 4               STD ERROR(HIGHTEMP)    48.27%

     EFFECT(LOW TEMP)  = EXP(-0.021126(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP (-0.038767 (TEMP-86.5))
```

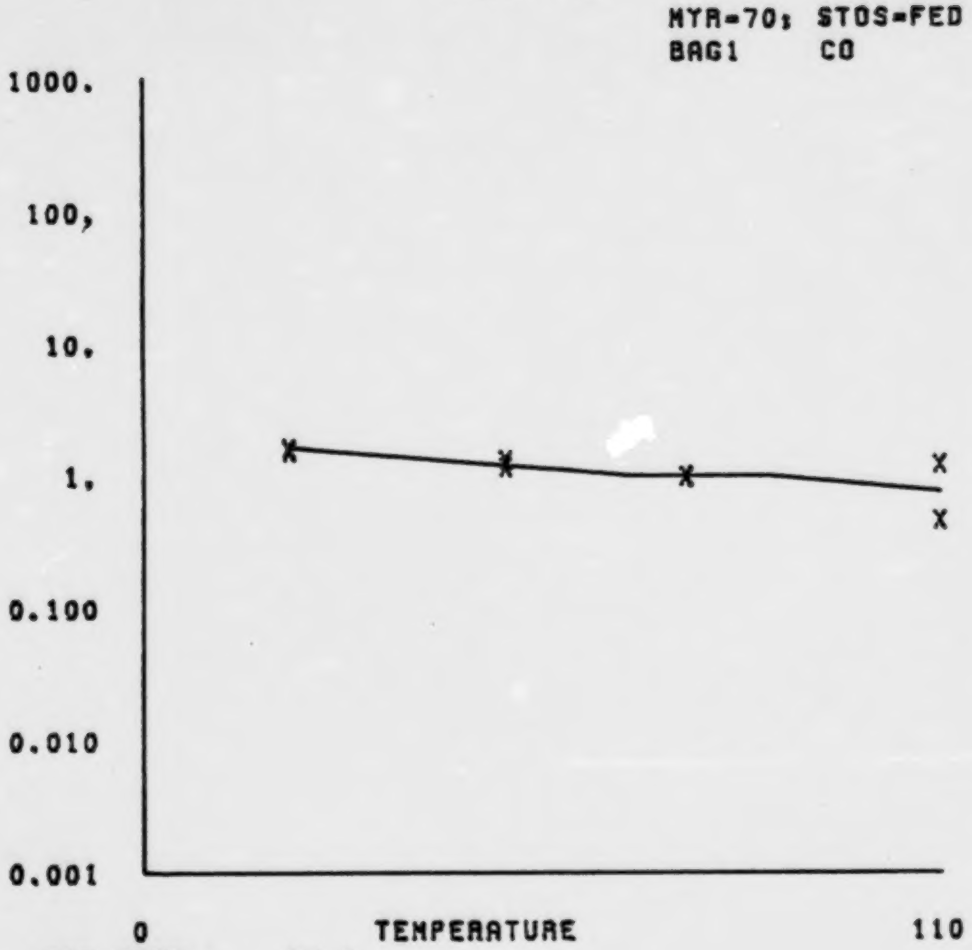
EXHIBIT 3.08

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO   69FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	4.1621
5.0	3.7449
10.0	3.3695
15.0	3.0317
20.0	2.7278
25.0	2.4544
30.0	2.2083
35.0	1.9870
40.0	1.7878
45.0	1.6086
50.0	1.4473
55.0	1.3022
60.0	1.1717
65.0	1.0542
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.8731
95.0	0.7193
100.0	0.5925
105.0	0.4881
110.0	0.4021

EXHIBIT 3.09



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 4                 STD ERROR(LOW TEMP)     6.16%
N(FTP TEMP) 2                 STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 2                 STD ERROR(HIGHTEMP)    48.82%

      EFFECT(LOW TEMP)  = EXP(-0.010369(TEMP-67.5))
      EFFECT(HIGHTEMP)  = EXP(-0.011980(TEMP-88.5))
```

EXHIBIT 3.10

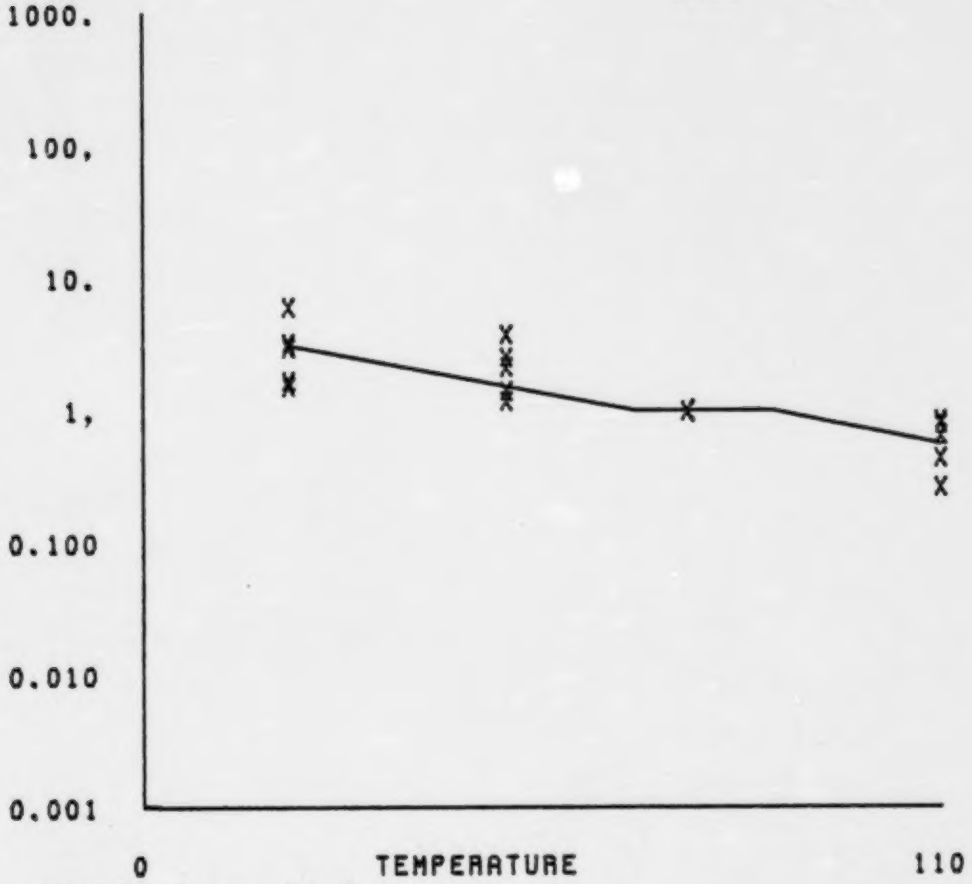
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO   70FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.0136
5.0	1.9118
10.0	1.8152
15.0	1.7235
20.0	1.6364
25.0	1.5538
30.0	1.4753
35.0	1.4007
40.0	1.3300
45.0	1.2628
50.0	1.1990
55.0	1.1384
60.0	1.0809
65.0	1.0263
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9589
95.0	0.9032
100.0	0.8507
105.0	0.8012
110.0	0.7546

EXHIBIT 3.11

MYR=71; STDS=FED
BAG1 CO



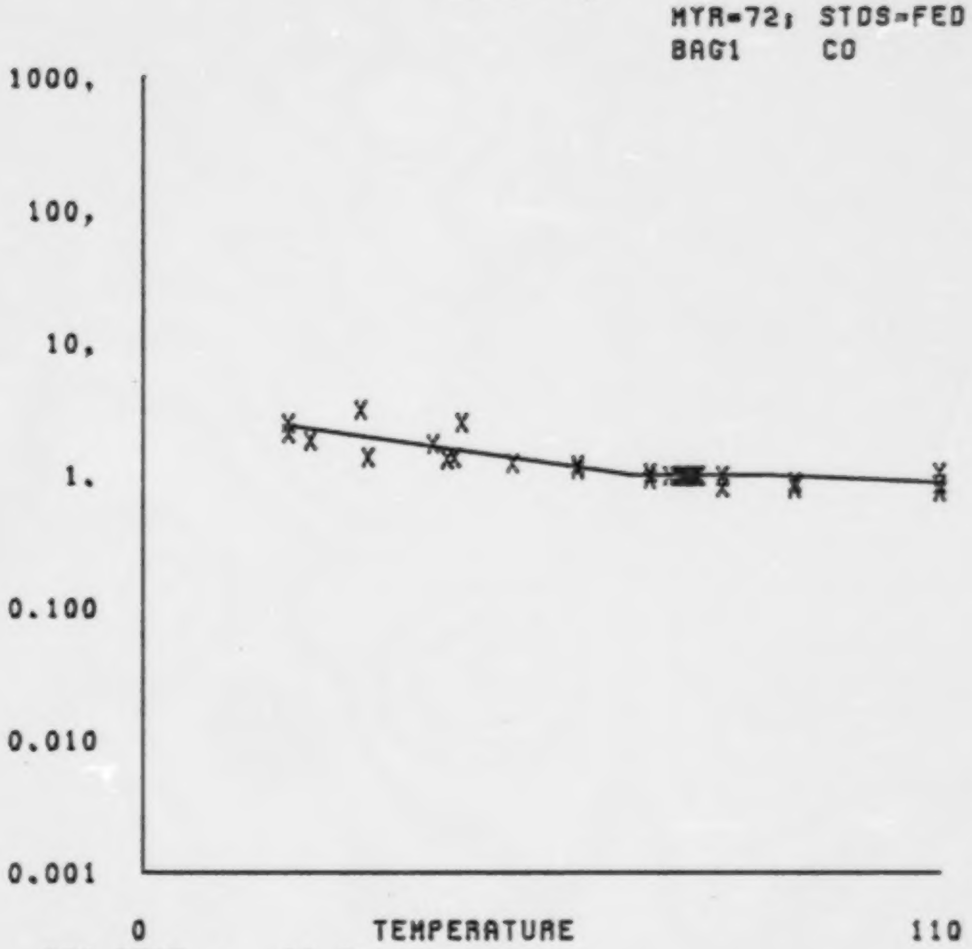
```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 10                STD ERROR(LOW TEMP)    51.20%
N(FTP TEMP) 5                 STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 5                 STD ERROR(HIGHTEMP)    43.15%

     EFFECT(LOW TEMP)  = EXP(-0.023565(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.025475(TEMP-86.5))
```

EXHIBIT 3.12
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO   71FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	4.9069
5.0	4.3615
10.0	3.8768
15.0	3.4459
20.0	3.0628
25.0	2.7224
30.0	2.4198
35.0	2.1509
40.0	1.9118
45.0	1.6993
50.0	1.5104
55.0	1.3425
60.0	1.1933
65.0	1.0607
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9147
95.0	0.8053
100.0	0.7090
105.0	0.6242
110.0	0.5496

EXHIBIT 3.13



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 12              STD ERROR(LOW TEMP)    24.17%
N(FTP TEMP) 12              STD ERROR(FTP TEMP)    12.07%
N(HIGHTEMP) 5               STD ERROR(HIGHTEMP)    14.39%

     EFFECT(LOW TEMP)  = EXP(-0.017868(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.005626(TEMP-86.5))
```

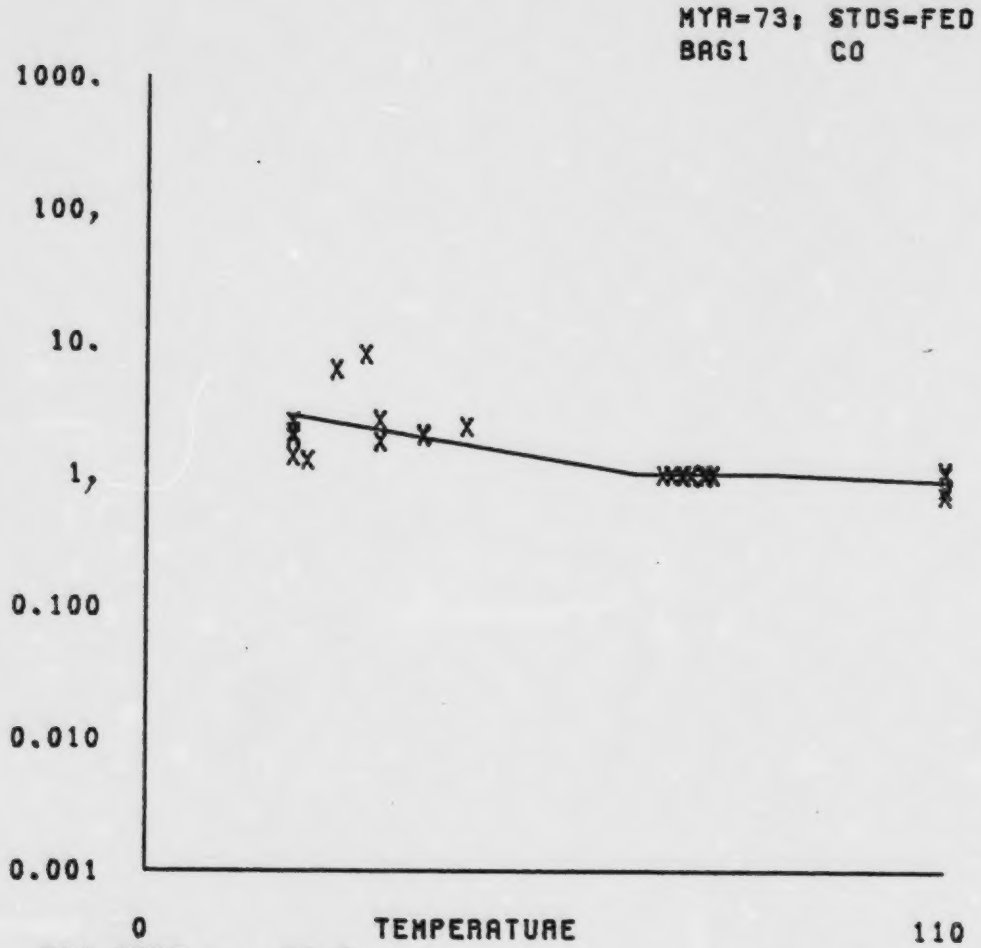
EXHIBIT 3.14

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO 72FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	3.3404
5.0	3.0549
10.0	2.7938
15.0	2.5550
20.0	2.3367
25.0	2.1370
30.0	1.9543
35.0	1.7873
40.0	1.6345
45.0	1.4949
50.0	1.3671
55.0	1.2503
60.0	1.1434
65.0	1.0457
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9805
95.0	0.9533
100.0	0.9269
105.0	0.9011
110.0	0.8761

EXHIBIT 3.15



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 12               STD ERROR(LOW TEMP)   58.05%
N(FTP TEMP) 12               STD ERROR(FTP TEMP)    0.0 %
N(HIGHTEMP) 4                STD ERROR(HIGHTEMP)   17.20%

     EFFECT(LOW TEMP)  = EXP(-0.021319(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.005275(TEMP-86.5))
```

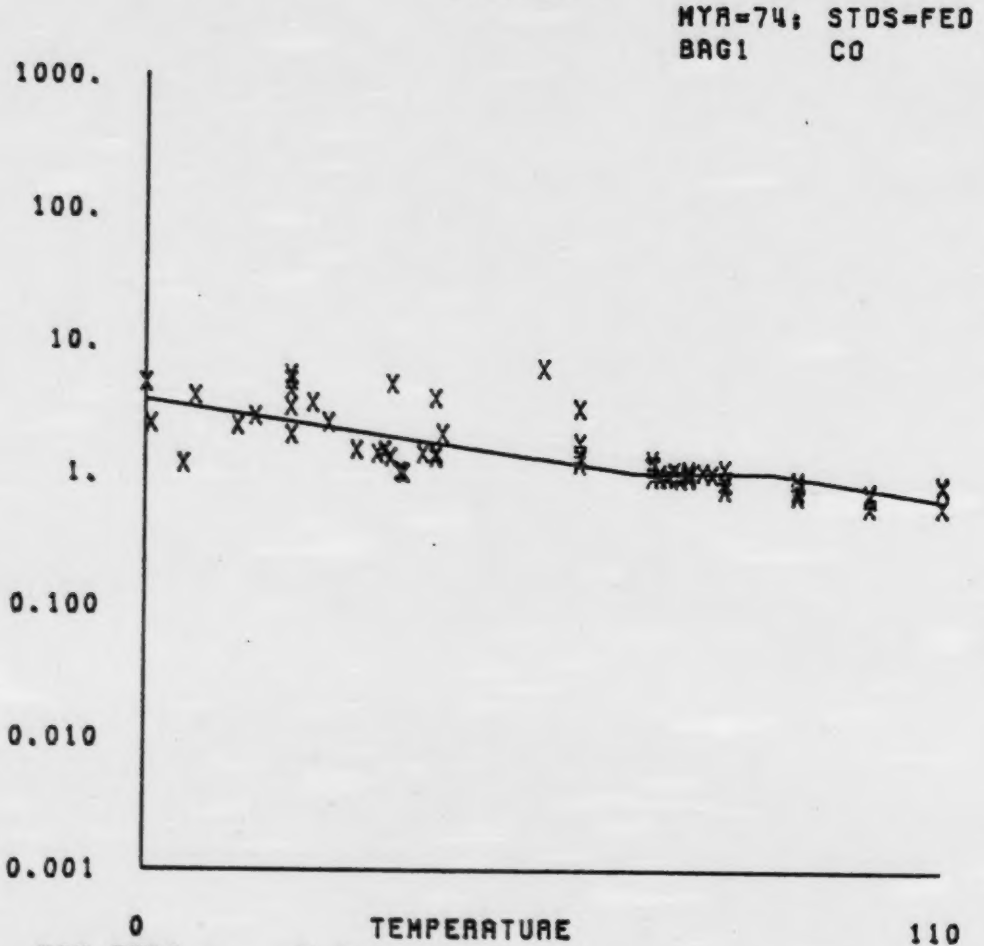
EXHIBIT 3.16

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO   73FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	4.2166
5.0	3.7903
10.0	3.4070
15.0	3.0625
20.0	2.7529
25.0	2.4745
30.0	2.2243
35.0	1.9994
40.0	1.7973
45.0	1.6156
50.0	1.4522
55.0	1.3054
60.0	1.1734
65.0	1.0547
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9817
95.0	0.9561
100.0	0.9313
105.0	0.9070
110.0	0.8834

EXHIBIT 3.17



```
MIN TEMP =   -6.9
MAX TEMP = 110.00

N(LOW TEMP) 34            STD ERROR(LOW TEMP)    54.65%
N(FTP TEMP) 27            STD ERROR(FTP TEMP)    14.26%
N(HIGHTEMP) 12            STD ERROR(HIGHTEMP)    19.99%

     EFFECT(LOW TEMP) = EXP(-0.018650 (TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.019975 (TEMP-86.5))
```

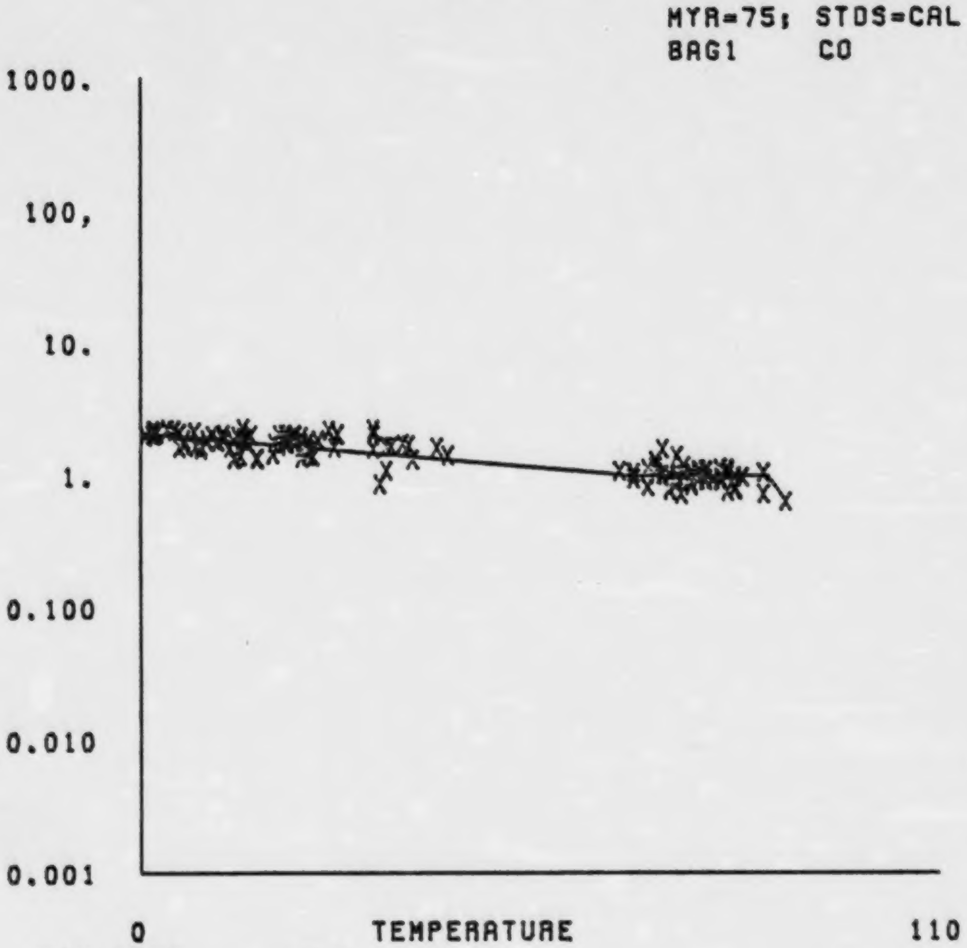
EXHIBIT 3.18

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO 74FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	3.5214
5.0	3.2079
10.0	2.9223
15.0	2.6621
20.0	2.4251
25.0	2.2092
30.0	2.0125
35.0	1.8333
40.0	1.6701
45.0	1.5214
50.0	1.3859
55.0	1.2625
60.0	1.1501
65.0	1.0477
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9325
95.0	0.8438
100.0	0.7636
105.0	0.6911
110.0	0.6254

EXHIBIT 3.19



```
MIN TEMP =   -7.1
MAX TEMP =  89.00

N(LOW TEMP) 88            STD ERROR(LOW TEMP)    17.05%
N(FTP TEMP) 50            STD ERROR(FTP TEMP)    16.28%
N(HIGHTEMP) 1             STD ERROR(HIGHTEMP)     0.0 %

     EFFECT(LOW TEMP) = EXP(-0.010834 (TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.173532(TEMP-86.5))
```

EXHIBIT 3.20

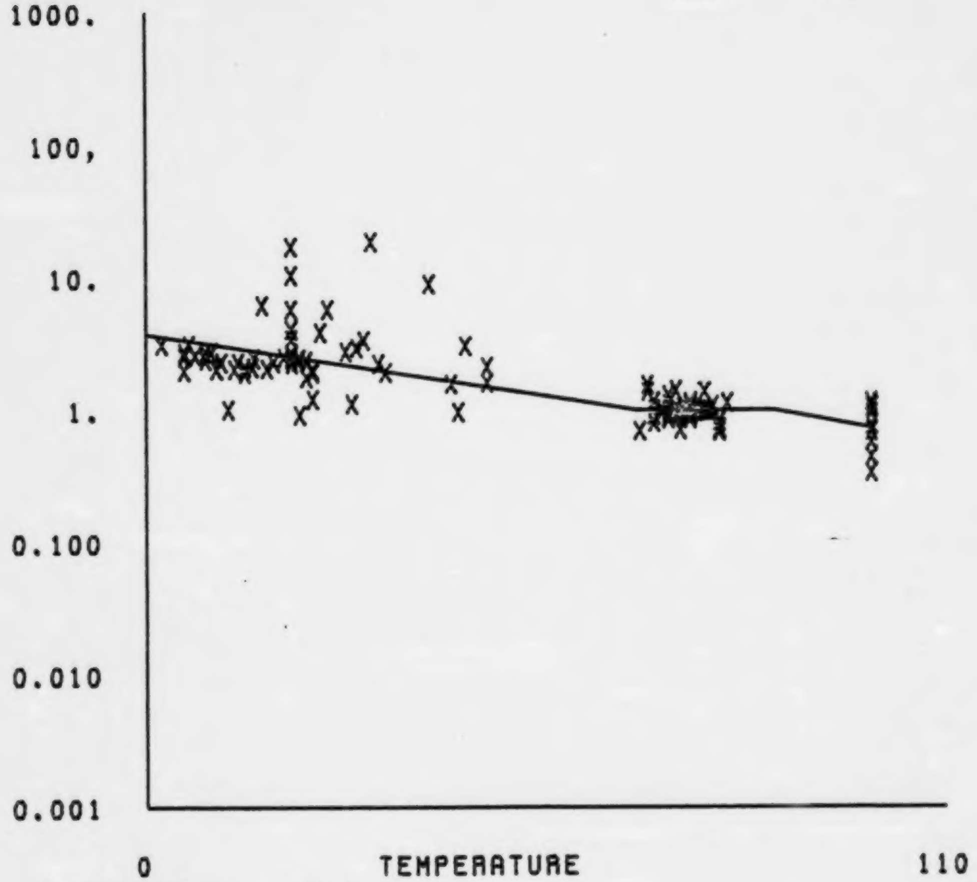
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO   75CAL

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.0778
5.0	1.9683
10.0	1.8645
15.0	1.7662
20.0	1.6730
25.0	1.5848
30.0	1.5012
35.0	1.4221
40.0	1.3471
45.0	1.2761
50.0	1.2088
55.0	1.1450
60.0	1.0847
65.0	1.0275
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.5448
95.0	0.2288
100.0	0.0961
105.0	0.0403
110.0	0.0169

EXHIBIT 3.21

```
MYR=75; STDS=FED
BAG1     CO
```



```
MIN TEMP =    -5.4
MAX TEMP = 100.00

N(LOW TEMP) 64                STD ERROR(LOW TEMP)    59.83%
N(FTP TEMP) 62                STD ERROR(FTP TEMP)    21.11%
N(HIGHTEMP) 9                 STD ERROR(HIGHTEMP)    40.05%

     EFFECT(LOW TEMP)  = EXP(-0.019712(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.023404(TEMP-86.5))
```

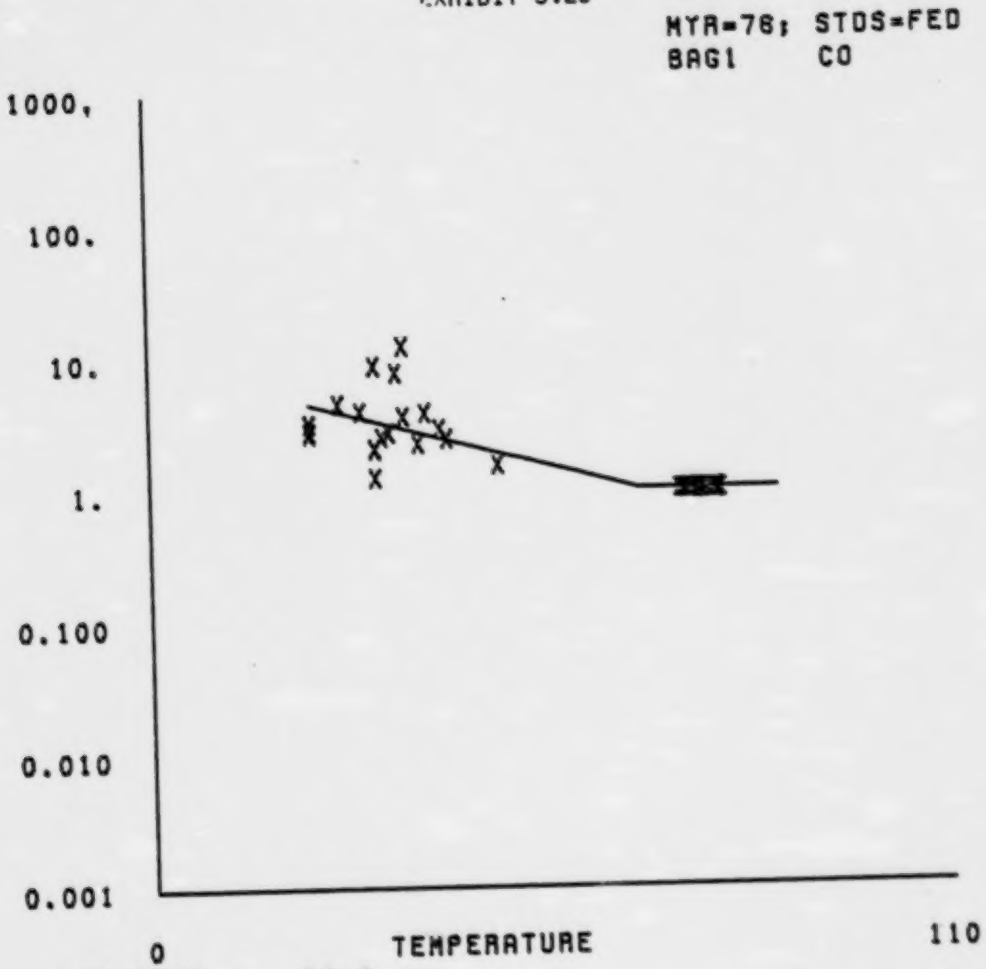
EXHIBIT 3.22

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO 75FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	3.7830
5.0	3.4280
10.0	3.1062
15.0	2.8147
20.0	2.5505
25.0	2.3111
30.0	2.0942
35.0	1.8977
40.0	1.7196
45.0	1.5582
50.0	1.4119
55.0	1.2794
60.0	1.1593
65.0	1.0505
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9214
95.0	0.8196
100.0	0.7291
105.0	0.6486
110.0	0.5770

EXHIBIT 3.23



MIN TEMP = 22.0
MAX TEMP = 78.70

N (LOW TEMP) 19
N (FTP TEMP) 19
N (HIGHTEMP) 0

STD ERROR (LOW TEMP) 57.61%
STD ERROR (FTP TEMP) 0.0 %
STD ERROR (HIGHTEMP) 0.0 %

EFFECT (LOW TEMP) = EXP (-0.033318 (TEMP-67.5))

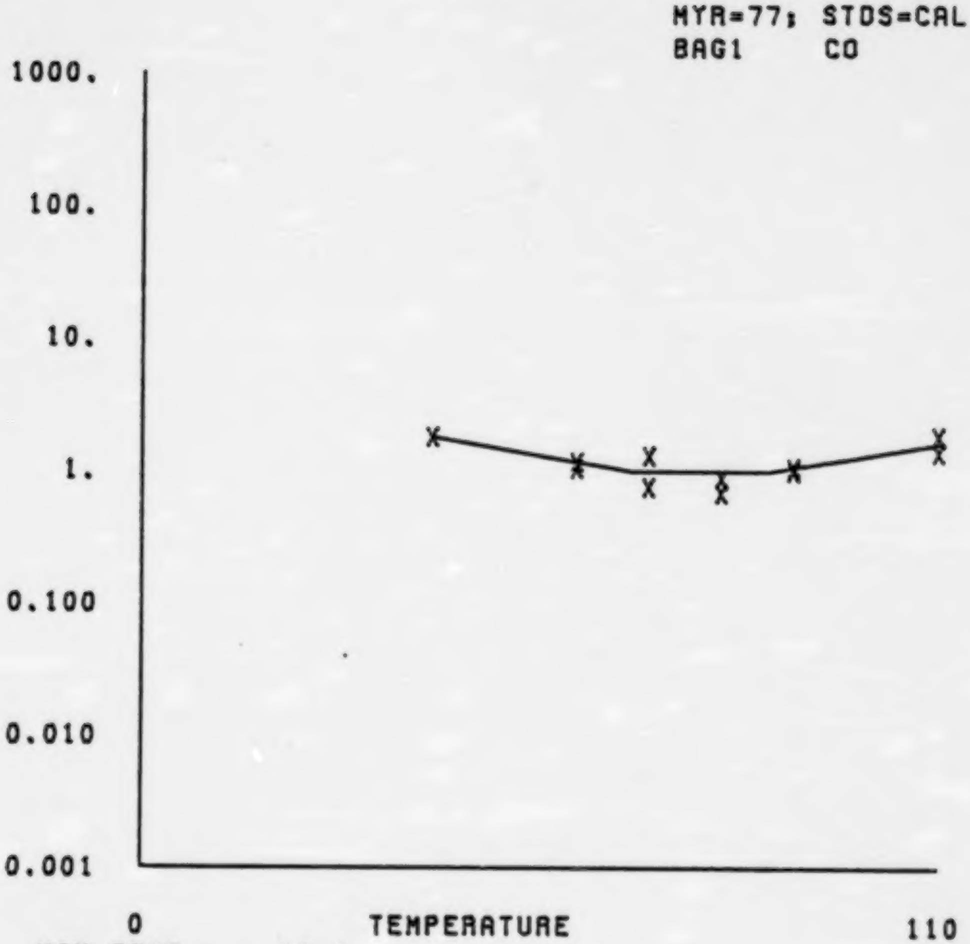
EXHIBIT 3.24

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO 76FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	9.4777
5.0	8.0234
10.0	6.7922
15.0	5.7499
20.0	4.8676
25.0	4.1206
30.0	3.4883
35.0	2.9530
40.0	2.4999
45.0	2.1163
50.0	1.7915
55.0	1.5166
60.0	1.2839
65.0	1.0869
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	No data
95.0	" "
100.0	" "
105.0	" "
110.0	" "

EXHIBIT 3.25



```
MIN TEMP =   40.0
MAX TEMP = 110.00

N(LOW TEMP) 3                 STD ERROR(LOW TEMP)     5.92%
N(FTP TEMP) 4                 STD ERROR(FTP TEMP)    31.02%
N(HIGHTEMP) 4                 STD ERROR(HIGHTEMP)    10.47%

     EFFECT(LOW TEMP) = EXP(-0.021353(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP( 0.020809(TEMP-86.5))
```

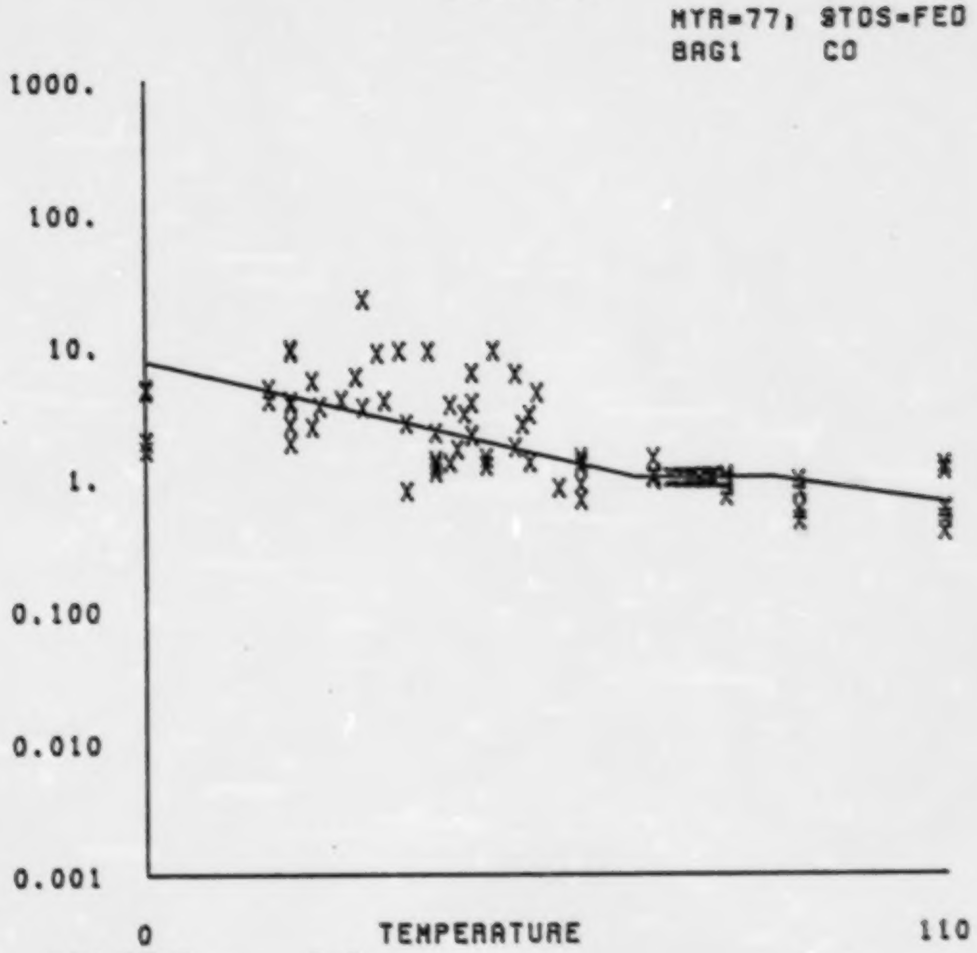
EXHIBIT 3.26

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO 77CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	4.2262
5.0	3.7982
10.0	3.4136
15.0	3.0680
20.0	2.7573
25.0	2.4781
30.0	2.2271
35.0	2.0016
40.0	1.7989
45.0	1.6168
50.0	1.4531
55.0	1.3059
60.0	1.1737
65.0	1.0548
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0756
95.0	1.1935
100.0	1.3244
105.0	1.4696
110.0	1.6307

EXHIBIT 3.27



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 52                STD ERROR(LOW TEMP)    74.40%
N(FTP TEMP) 48                STD ERROR(FTP TEMP)    16.80%
N(HIGHTEMP) 12                STD ERROR(HIGHTEMP)    40.06%

     EFFECT(LOW TEMP) = EXP(-0.030078(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.019312(TEMP-86.5))
```

EXHIBIT 3.28

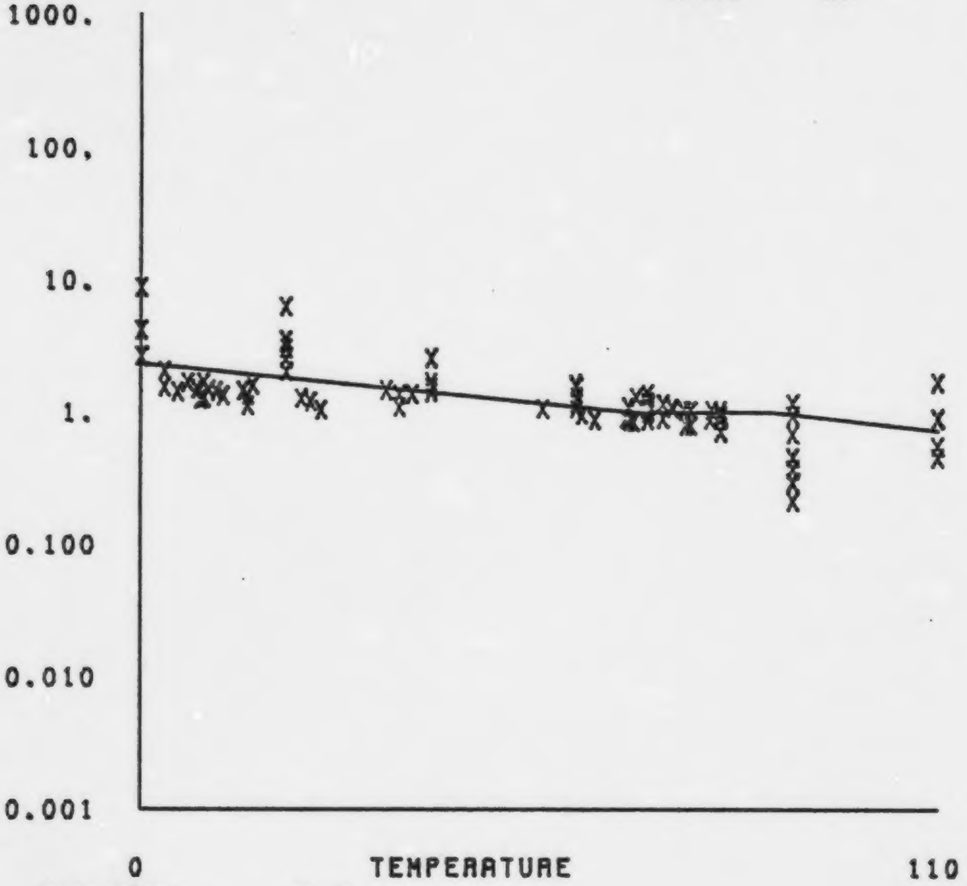
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO 77FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	7.6162
5.0	6.5527
10.0	5.6378
15.0	4.8506
20.0	4.1733
25.0	3.5906
30.0	3.0893
35.0	2.6579
40.0	2.2868
45.0	1.9675
50.0	1.6928
55.0	1.4564
60.0	1.2531
65.0	1.0781
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9346
95.0	0.8486
100.0	0.7705
105.0	0.6996
110.0	0.6352

EXHIBIT 3.29

MYR=78; STDS=CAL
BAG1 CO



MIN TEMP = -3.8
MAX TEMP = 110.00

N (LOW TEMP)	50	STD ERROR (LOW TEMP)	41.60%
N (FTP TEMP)	28	STD ERROR (FTP TEMP)	18.23%
N (HIGHTEMP)	12	STD ERROR (HIGHTEMP)	71.82%

EFFECT (LOW TEMP) = EXP (-0.012442 (TEMP-67.5))
EFFECT (HIGHTEMP) = EXP (-0.014028 (TEMP-86.5))

EXHIBIT 3.30

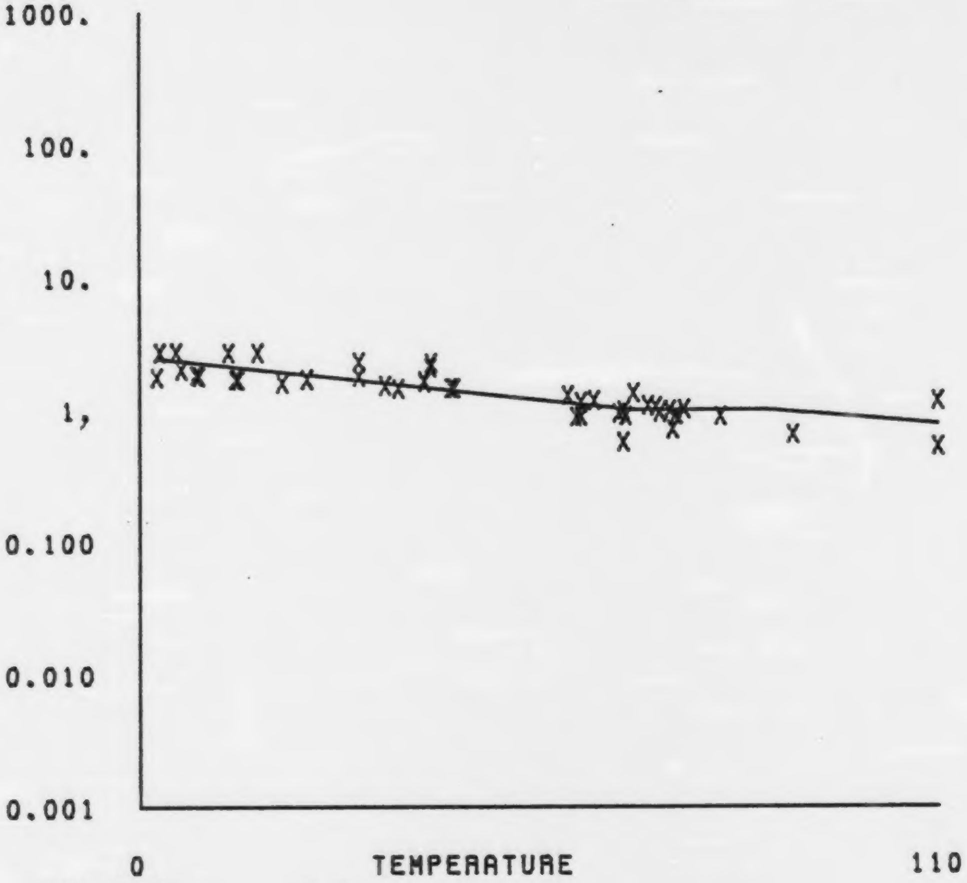
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO 78CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.3160
5.0	2.1763
10.0	2.0451
15.0	1.9217
20.0	1.8058
25.0	1.6969
30.0	1.5945
35.0	1.4984
40.0	1.4080
45.0	1.3231
50.0	1.2433
55.0	1.1683
60.0	1.0978
65.0	1.0316
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9521
95.0	0.8876
100.0	0.8275
105.0	0.7714
110.0	0.7192

EXHIBIT 3.31

MYR=78; STDS=FED
BAG1 CO



```
MIN TEMP =     2.3
MAX TEMP = 110.00

N(LOW TEMP) 34              STD ERROR(LOW TEMP)    21.03%
N(FTP TEMP) 9               STD ERROR(FTP TEMP)    21.53%
N(HIGHTEMP) 3               STD ERROR(HIGHTEMP)    39.27%

      EFFECT(LOW TEMP)  = EXP(-0.013586(TEMP-67.5))
      EFFECT(HIGHTEMP)  = EXP(-0.010885(TEMP-86.5))
```

EXHIBIT 3.32

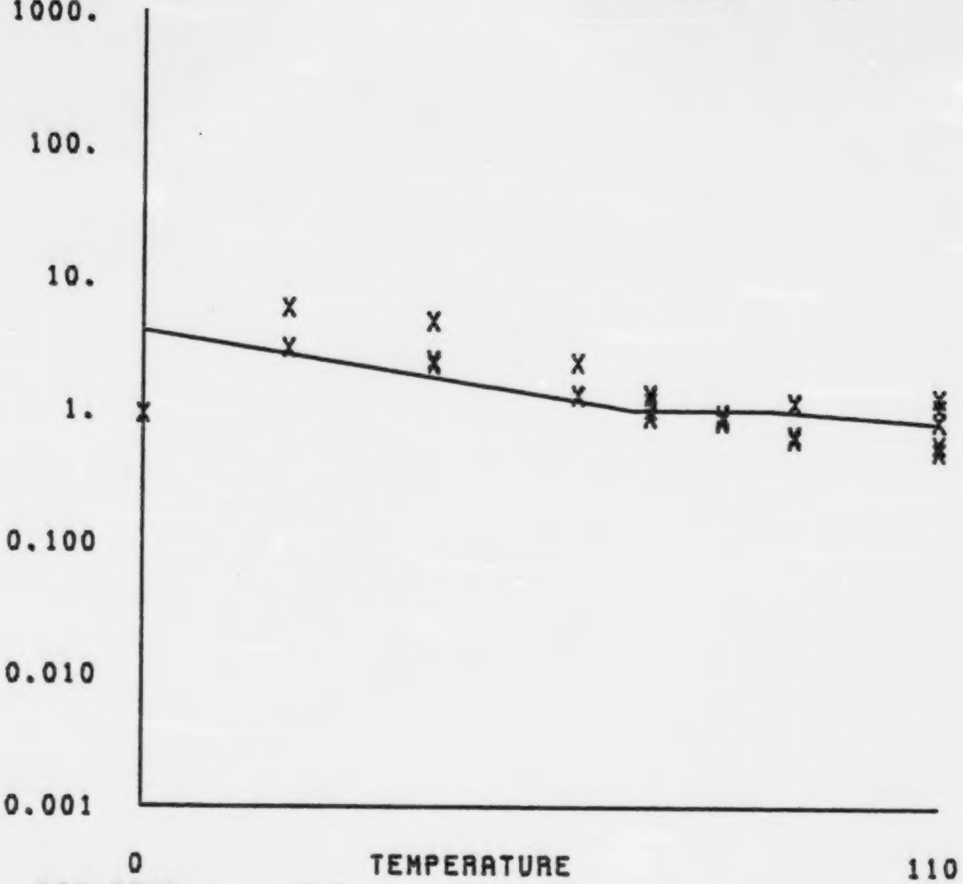
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO 78FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.5019
5.0	2.3376
10.0	2.1841
15.0	2.0406
20.0	1.9066
25.0	1.7814
30.0	1.6644
35.0	1.5551
40.0	1.4530
45.0	1.3575
50.0	1.2684
55.0	1.1851
60.0	1.1073
65.0	1.0345
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9626
95.0	0.9116
100.0	0.8633
105.0	0.8176
110.0	0.7743

EXHIBIT 3.33

MYR=80; STDS=FED
BAG1 CO



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP)  9            STD ERROR(LOW TEMP)    69.79%
N(FTP TEMP)  11           STD ERROR(FTP TEMP)    18.51%
N(HIGHTEMP)  10           STD ERROR(HIGHTEMP)    32.31%

     EFFECT(LOW TEMP)  = EXP(-0.020228(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.009611(TEMP-86.5))
```

EXHIBIT 3.34

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF CO 80FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	3.9173
5.0	3.5405
10.0	3.1999
15.0	2.8921
20.0	2.6139
25.0	2.3624
30.0	2.1352
35.0	1.9298
40.0	1.7442
45.0	1.5764
50.0	1.4247
55.0	1.2877
60.0	1.1638
65.0	1.0519
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9669
95.0	0.9216
100.0	0.8783
105.0	0.8371
110.0	0.7978

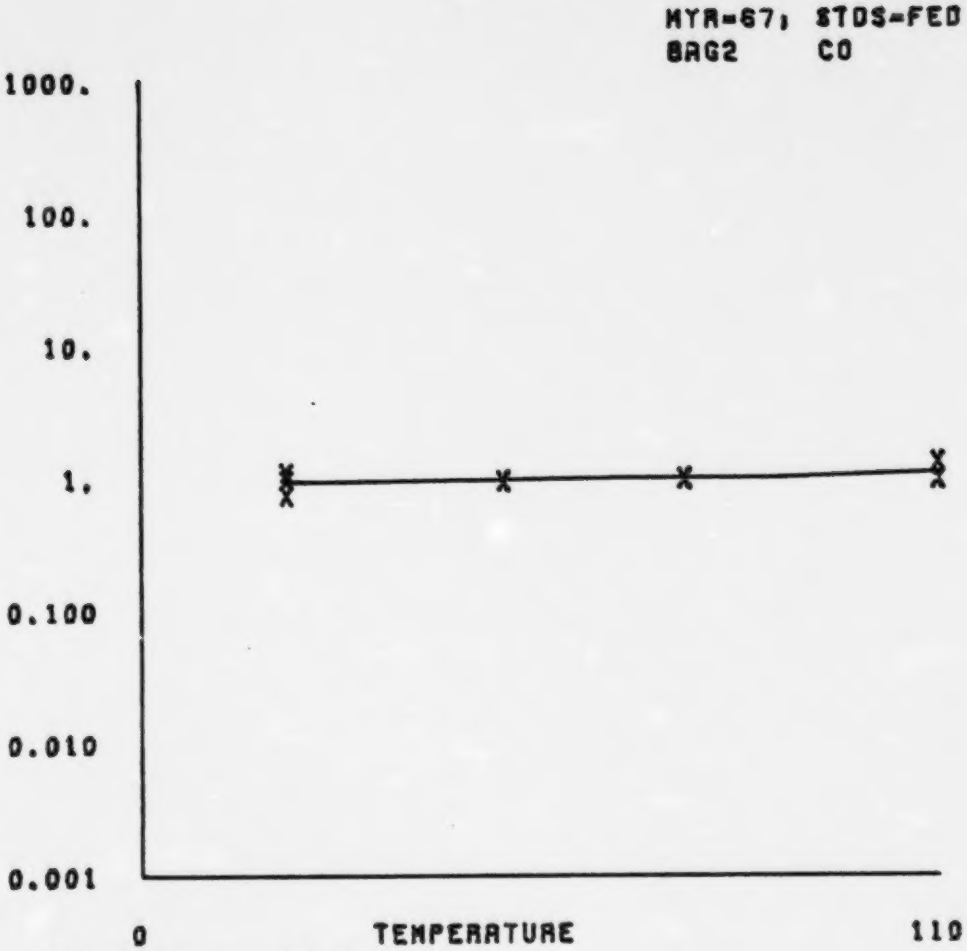
EXHIBIT 3.35: FITTED TEMPERATURE EFFECTS, CO BAG2

$$\frac{\text{EMISSIONS AT TEMPERATURE T}}{\text{EMISSIONS AT FTP TEMPERATURE}} = \begin{cases} \exp[c(T-67.5)] \text{ for T less than 67.5} \\ \exp[d(T-86.5)] \text{ for T greater than 86.5} \end{cases}$$

where exp is the exponential function and c and d are as tabled below.

MYR STDS	c	d
67FED	.00157835	.00374618
69FED	-.00152889	.00846846
70FED	-.00005995	.01444131
71FED	-.00783031	.02677715
72FED	.00292061	.02118243
73FED	-.00629096	.01971782
74FED	.00183590	.02760224
75CAL	-.00276673	-.26566917
75FED	-.01096163	.03218665
76FED	-.00283836	NO DATA
77CAL	.06293870	.04592155
77FED	-.01205305	.03159126
78CAL	.00633154	.05004029
78FED	-.00231308	.09941457
80FED	.00467379	.01673225

EXHIBIT 3.36



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP)  6              STD ERROR(LOW TEMP)    11.57%
N(FTP TEMP)  3              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP)  3              STD ERROR(HIGHTEMP)    13.81%

     EFFECT(LOW TEMP)  = EXP( 0.001578(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.003746(TEMP-86.5))
```

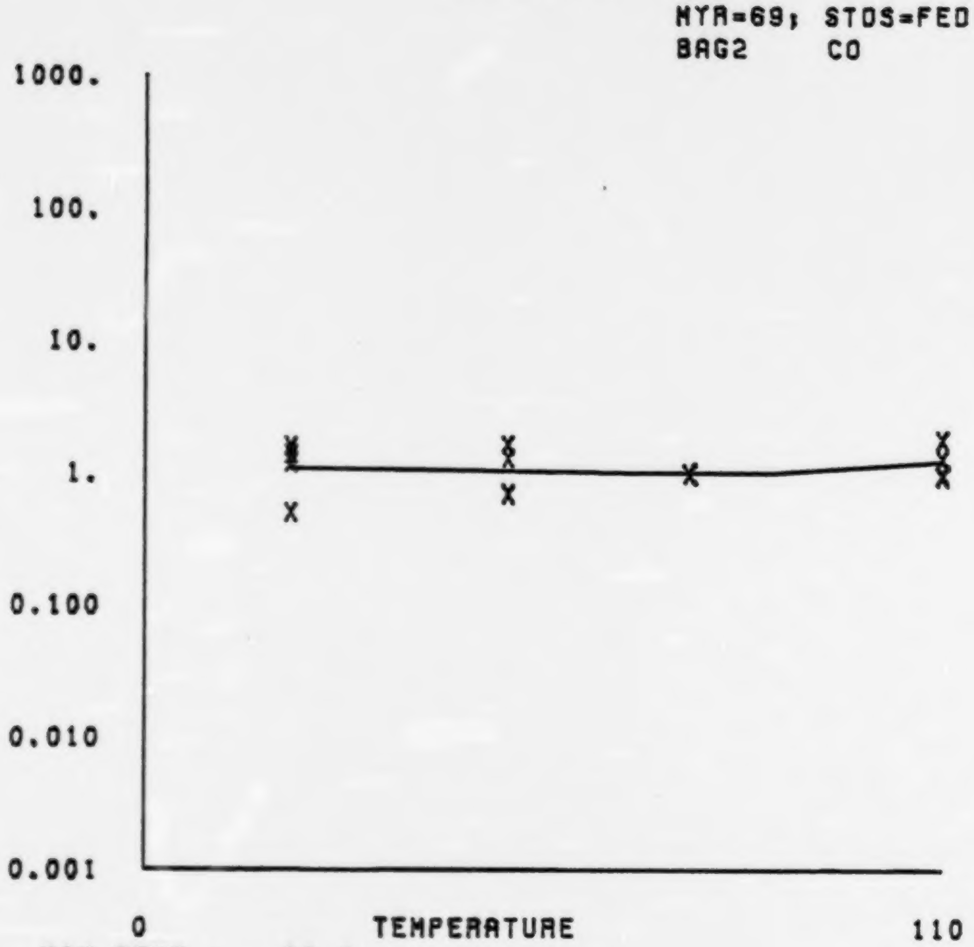
EXHIBIT 3.37

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 67FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.8989
5.0	0.9061
10.0	0.9132
15.0	0.9205
20.0	0.9278
25.0	0.9351
30.0	0.9425
35.0	0.9500
40.0	0.9575
45.0	0.9651
50.0	0.9728
55.0	0.9805
60.0	0.9882
65.0	0.9961
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0132
95.0	1.0324
100.0	1.0519
105.0	1.0718
110.0	1.0920

EXHIBIT 3.38



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 8            STD ERROR(LOW TEMP)   41.73%
N(FTP TEMP) 4            STD ERROR(FTP TEMP)    0.0 %
N(HIGHTEMP) 4            STD ERROR(HIGHTEMP)   25.58%

     EFFECT(LOW TEMP)  = EXP(-0.001529(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.008468(TEMP-86.5))
```

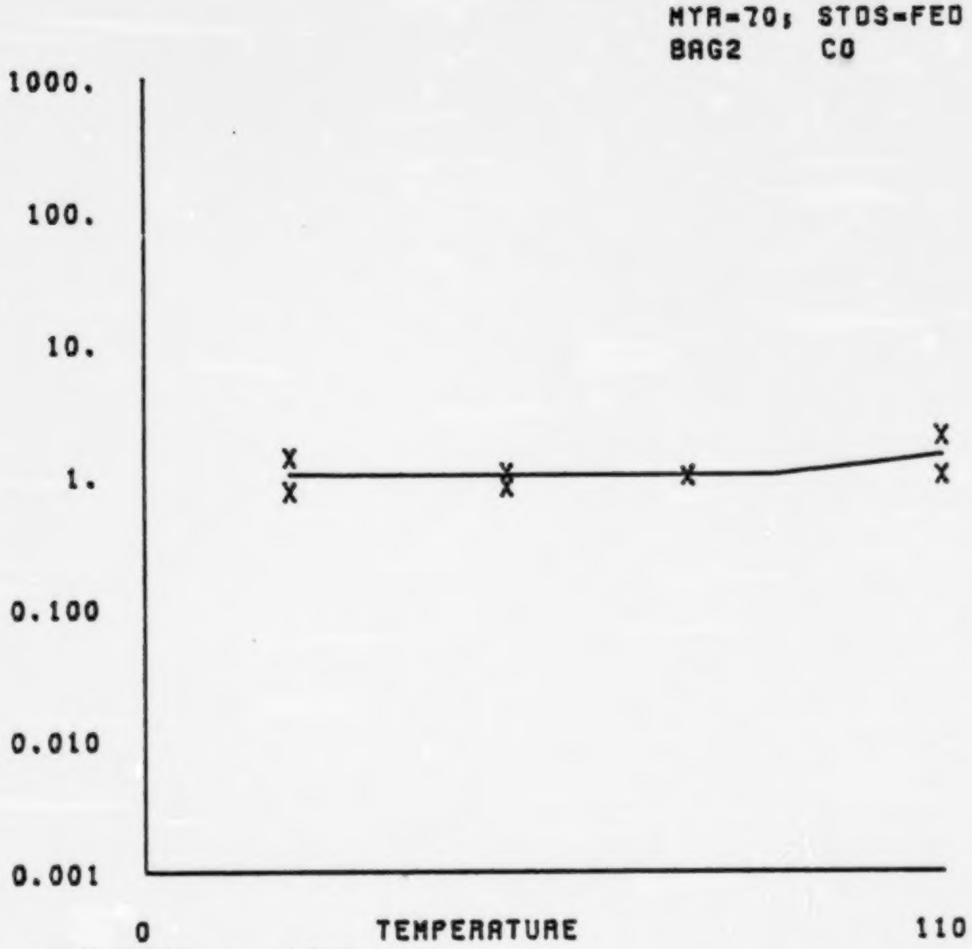
EXHIBIT 3.39

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 69FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.1087
5.0	1.1003
10.0	1.0919
15.0	1.0836
20.0	1.0753
25.0	1.0671
30.0	1.0590
35.0	1.0509
40.0	1.0429
45.0	1.0350
50.0	1.0271
55.0	1.0193
60.0	1.0115
65.0	1.0038
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0301
95.0	1.0746
100.0	1.1211
105.0	1.1696
110.0	1.2202

EXHIBIT 3.40



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 4                STD ERROR(LOW TEMP)    23.36%
N(FTP TEMP) 2                STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 2                STD ERROR(HIGHTEMP)    34.37%

     EFFECT(LOW TEMP)  = EXP(-0.000060(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.014441(TEMP-86.5))
```

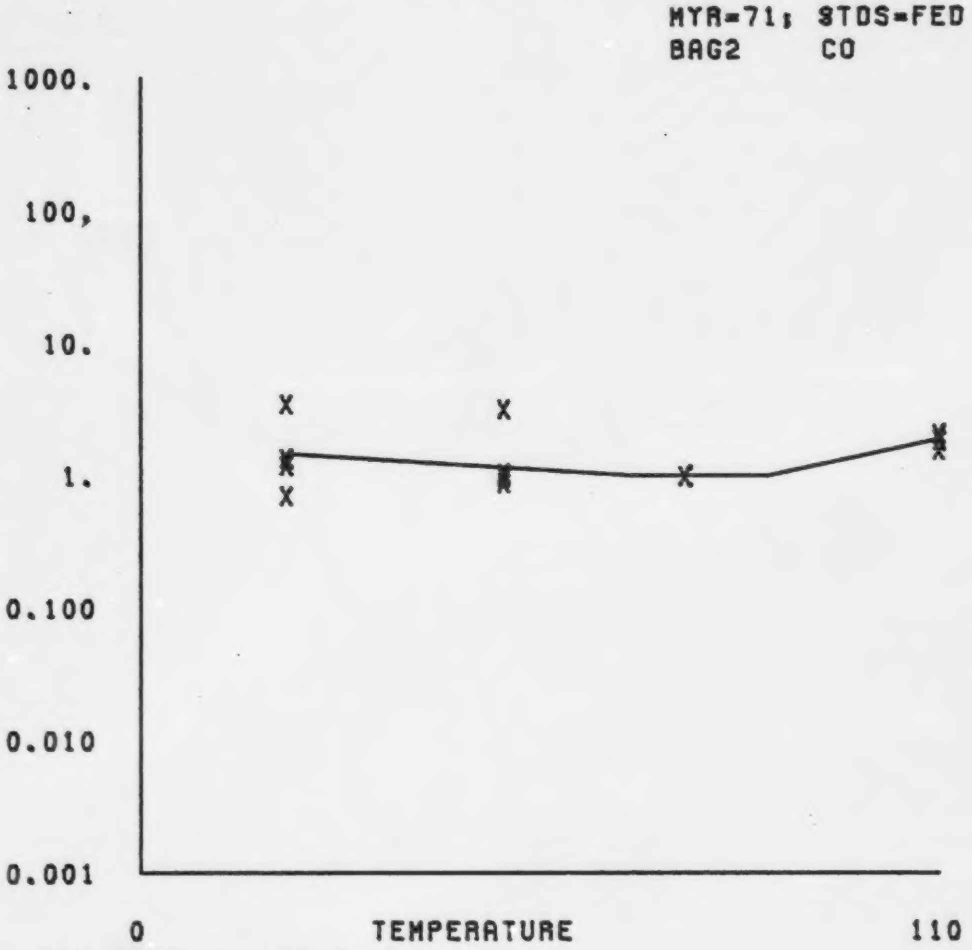
EXHIBIT 3.41

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 70FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0041
5.0	1.0038
10.0	1.0035
15.0	1.0032
20.0	1.0029
25.0	1.0026
30.0	1.0023
35.0	1.0020
40.0	1.0016
45.0	1.0013
50.0	1.0010
55.0	1.0007
60.0	1.0005
65.0	1.0001
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0518
95.0	1.1306
100.0	1.2153
105.0	1.3063
110.0	1.4041

EXHIBIT 3.42



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 10          STD ERROR(LOW TEMP)    49.90%
N(FTP TEMP) 5           STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 5           STD ERROR(HIGHTEMP)    10.77%

      EFFECT(LOW TEMP)  = EXP(-0.007830(TEMP-67.5))
      EFFECT(HIGHTEMP)  = EXP( 0.026777(TEMP-86.5))
```

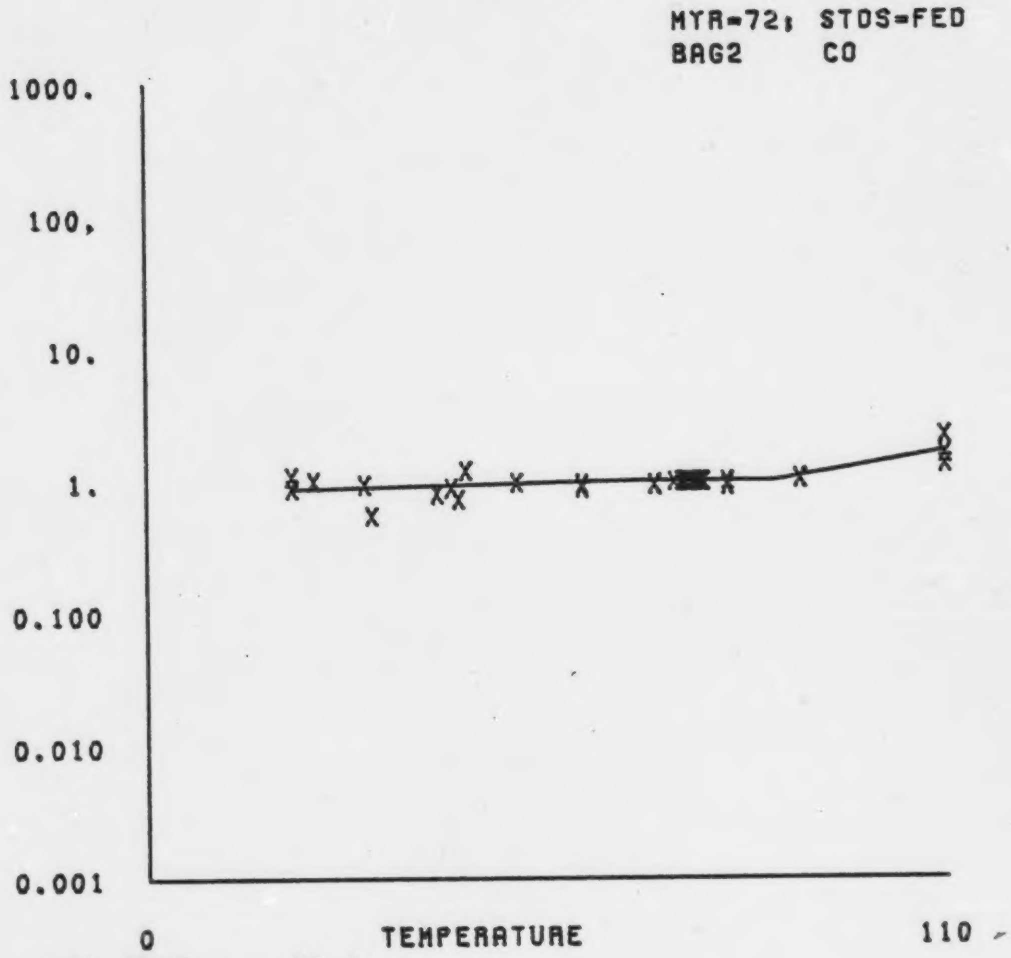
EXHIBIT 3.43

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 71FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.6965
5.0	1.6313
10.0	1.5687
15.0	1.5085
20.0	1.4505
25.0	1.3949
30.0	1.3413
35.0	1.2898
40.0	1.2403
45.0	1.1927
50.0	1.1469
55.0	1.1028
60.0	1.0605
65.0	1.0198
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0983
95.0	1.2556
100.0	1.4355
105.0	1.6411
110.0	1.8762

EXHIBIT 3.44



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 12              STD ERROR(LOW TEMP)    19.60%
N(FTP TEMP) 12              STD ERROR(FTP TEMP)     5.89%
N(HIGHTEMP) 5               STD ERROR(HIGHTEMP)    16.10%

     EFFECT(LOW TEMP) = EXP( 0.002921(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP( 0.021182(TEMP-88.5))
```

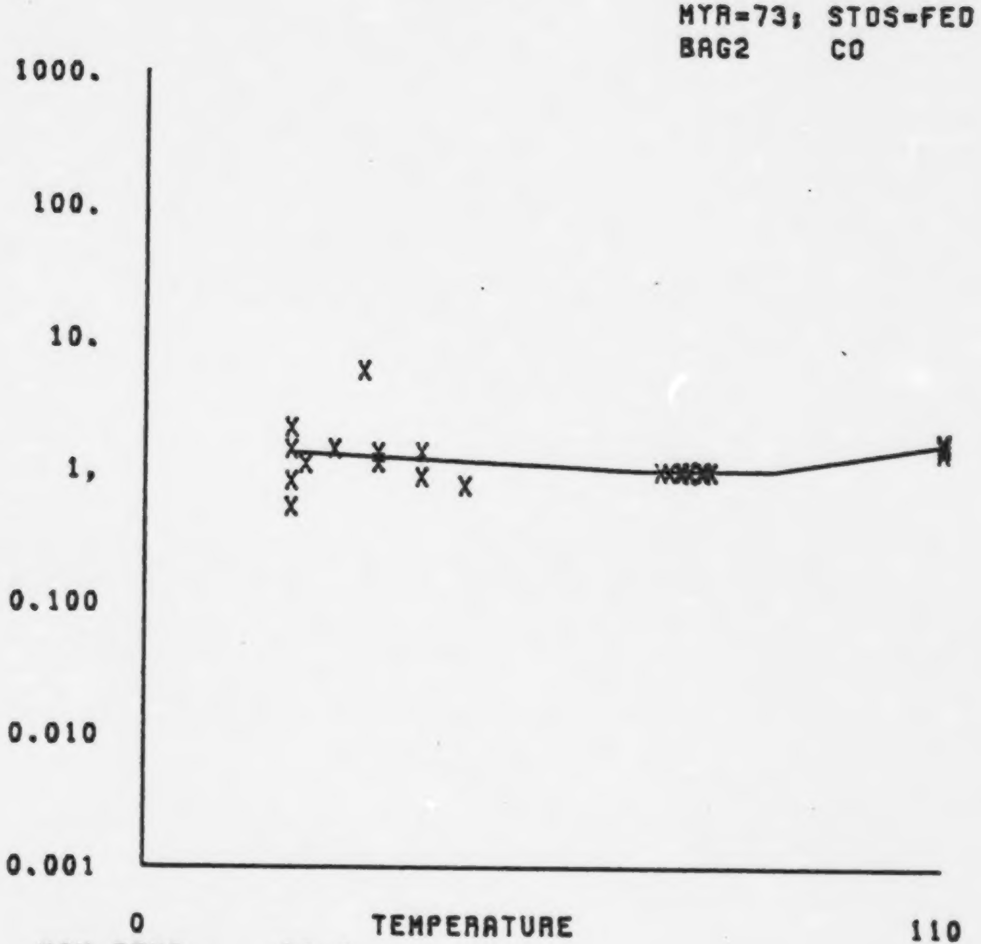
EXHIBIT 3.45

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 72FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.8211
5.0	0.8332
10.0	0.8454
15.0	0.8578
20.0	0.8705
25.0	0.8833
30.0	0.8963
35.0	0.9094
40.0	0.9228
45.0	0.9364
50.0	0.9502
55.0	0.9642
60.0	0.9783
65.0	0.9927
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0770
95.0	1.1973
100.0	1.3310
105.0	1.4798
110.0	1.6451

EXHIBIT 3.46



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP)  12              STD ERROR(LOW TEMP)    56.97%
N(FTP TEMP)  12              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP)  4               STD ERROR(HIGHTEMP)     7.37%

     EFFECT(LOW TEMP)  = EXP(-0.006291(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.019718(TEMP-86.5))
```

EXHIBIT 3.47

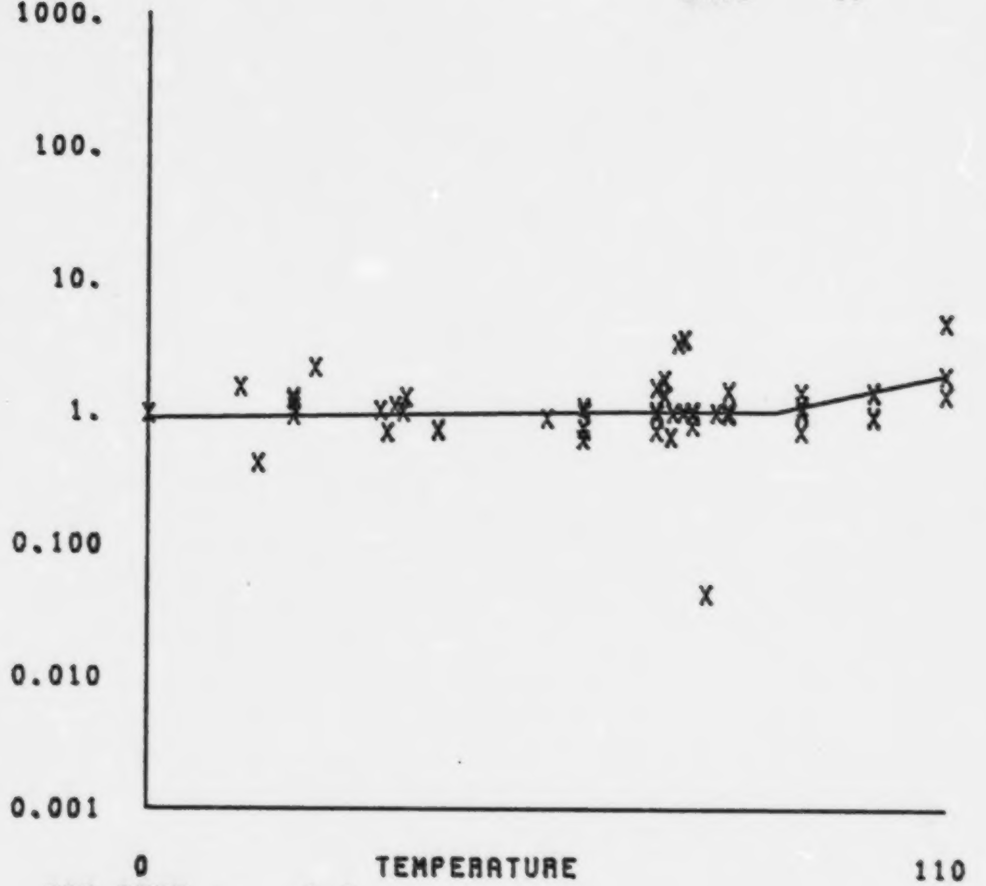
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 73FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.5290
5.0	1.4817
10.0	1.4358
15.0	1.3914
20.0	1.3483
25.0	1.3065
30.0	1.2661
35.0	1.2269
40.0	1.1889
45.0	1.1521
50.0	1.1164
55.0	1.0818
60.0	1.0483
65.0	1.0159
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0714
95.0	1.1825
100.0	1.3050
105.0	1.4402
110.0	1.5894

EXHIBIT 3.48

MYR=74; STDS=FED
BAG2 CO



```
MIN TEMP =   -6.9
MAX TEMP = 110.00

N(LOW TEMP) 24             STD ERROR(LOW TEMP)    35.64%
N(FTP TEMP) 27             STD ERROR(FTP TEMP)   100.31%
N(HIGHTEMP) 12             STD ERROR(HIGHTEMP)    36.67%

      EFFECT(LOW TEMP)  = EXP( 0.001836(TEMP-67.5))
      EFFECT(HIGHTEMP)  = EXP( 0.027602(TEMP-86.5))
```

EXHIBIT 3.49

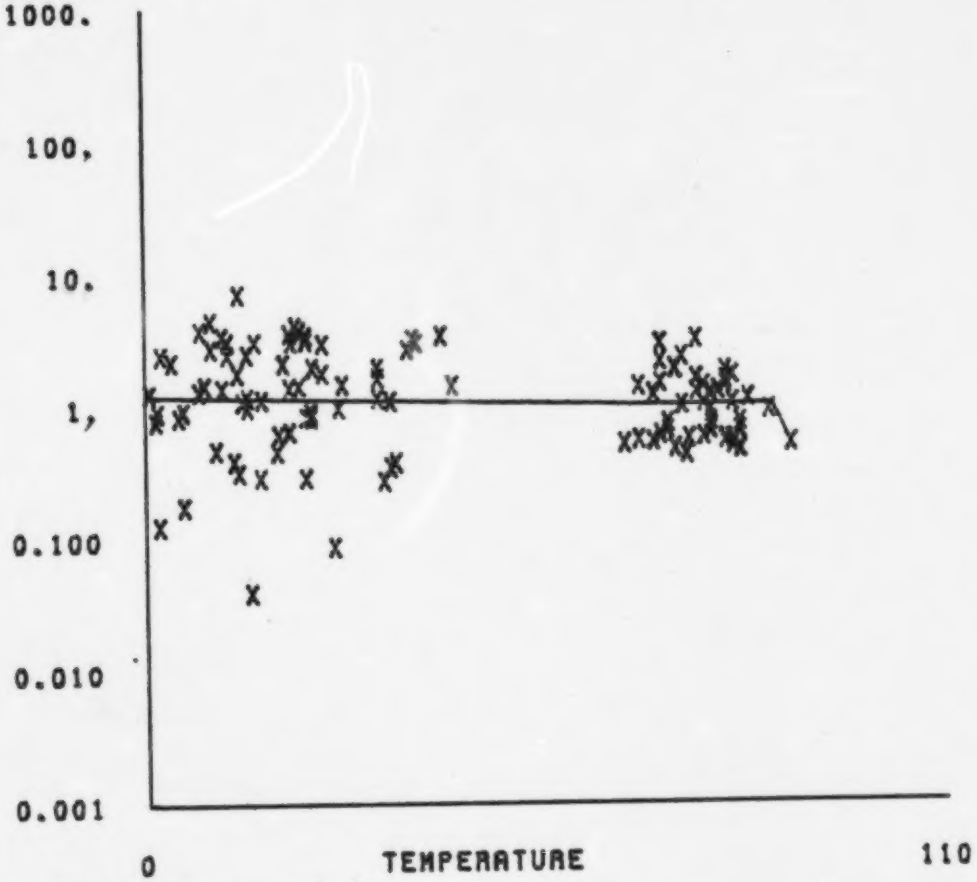
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 74FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.8834
5.0	0.8916
10.0	0.8998
15.0	0.9081
20.0	0.9165
25.0	0.9249
30.0	0.9335
35.0	0.9421
40.0	0.9508
45.0	0.9595
50.0	0.9684
55.0	0.9773
60.0	0.9863
65.0	0.9954
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1014
95.0	1.2644
100.0	1.4515
105.0	1.6664
110.0	1.9130

EXHIBIT 3.50

MYR=75; STDS=CAL
BAG2 CO



```
MIN TEMP =   -7.1
MAX TEMP =  89.00

N(LOW TEMP) 78             STD ERROR(LOW TEMP)    97.74%
N(FTP TEMP) 43             STD ERROR(FTP TEMP)    55.77%
N(HIGHTEMP) 1              STD ERROR(HIGHTEMP)     0.0 %

     EFFECT(LOW TEMP)  = EXP(-0.002767(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.265669(TEMP-88.5))
```

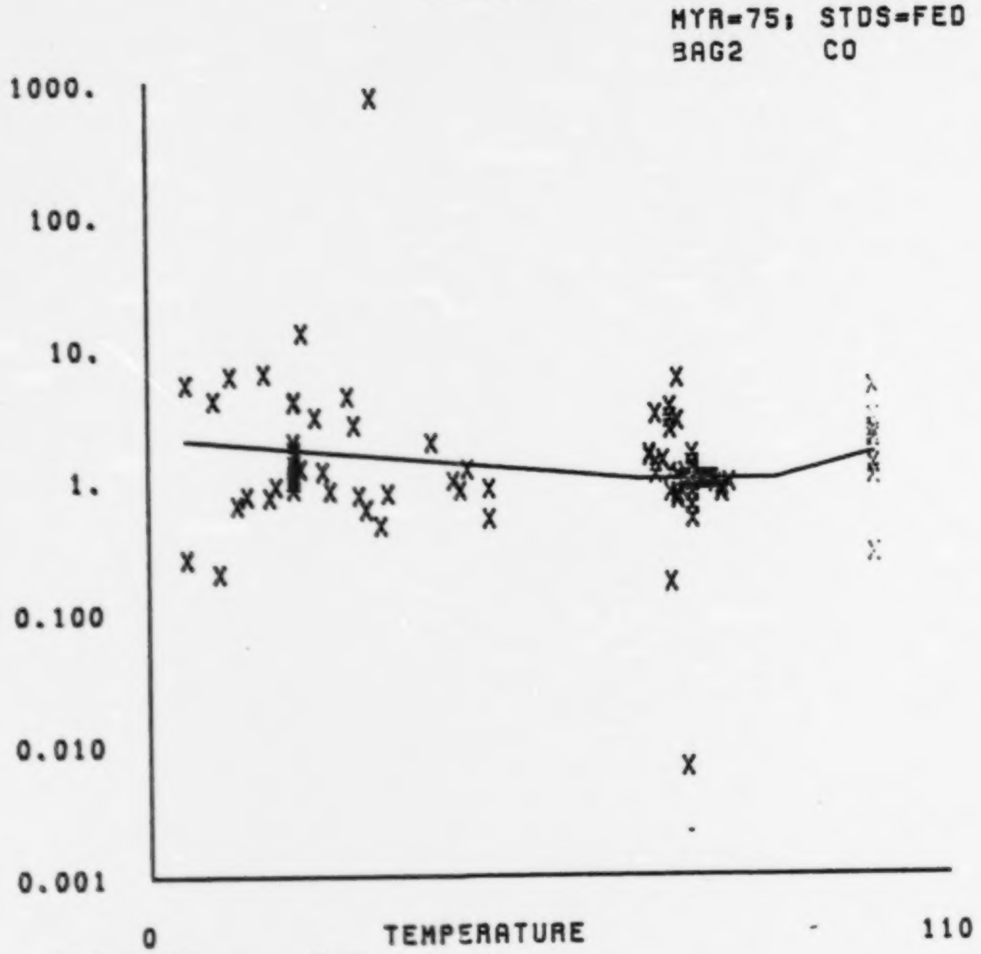
EXHIBIT 3.51

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 75CAL

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.2053
5.0	1.1888
10.0	1.1724
15.0	1.1563
20.0	1.1404
25.0	1.1248
30.0	1.1093
35.0	1.0941
40.0	1.0791
45.0	1.0642
50.0	1.0496
55.0	1.0352
60.0	1.0210
65.0	1.0069
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.3946
95.0	0.1045
100.0	0.0277
105.0	0.0073
110.0	0.0019

EXHIBIT 3.52



```
MIN TEMP =    5.2
MAX TEMP = 100.00

N(LOW TEMP) 39           STD ERROR(LOW TEMP)   133.78%
N(FTP TEMP) 57           STD ERROR(FTP TEMP)   116.36%
N(HIGHTEMP) 9            STD ERROR(HIGHTEMP)    76.18%

      EFFECT(LOW TEMP)  = EXP(-0.010962(TEMP-67.5))
      EFFECT(HIGHTEMP)  = EXP( 0.032187(TEMP-86.5))
```

EXHIBIT 3.53

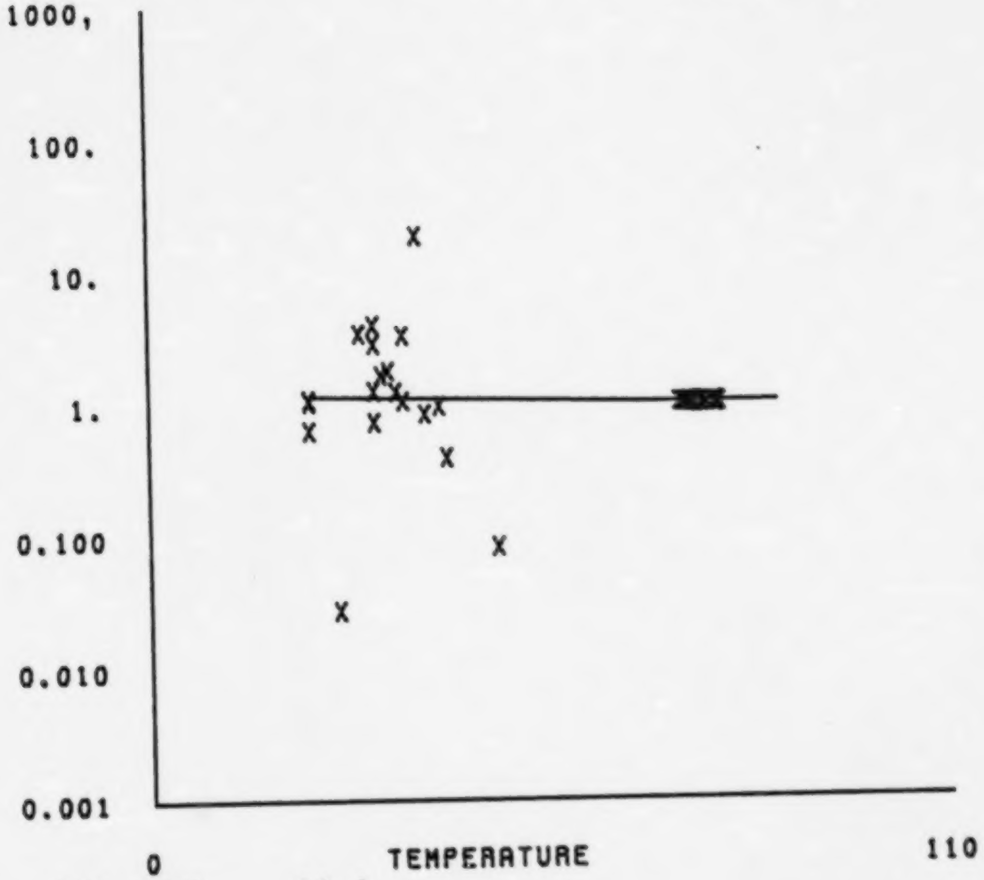
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 75FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.0957
5.0	1.9840
10.0	1.8782
15.0	1.7780
20.0	1.6832
25.0	1.5934
30.0	1.5084
35.0	1.4280
40.0	1.3518
45.0	1.2797
50.0	1.2115
55.0	1.1469
60.0	1.0857
65.0	1.0278
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1192
95.0	1.3147
100.0	1.5442
105.0	1.8139
110.0	2.1306

EXHIBIT 3.54

MYR=76; STDS=FED
BAG2 CO



```
MIN TEMP =   22.0
MAX TEMP =  78.70

N(LOW TEMP) 19          STD ERROR(LOW TEMP)   136.40%
N(FTP TEMP) 19          STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 0           STD ERROR(HIGHTEMP)     0.0 %

      EFFECT(LOW TEMP) = EXP(-0.002838 (TEMP-67.5))
```

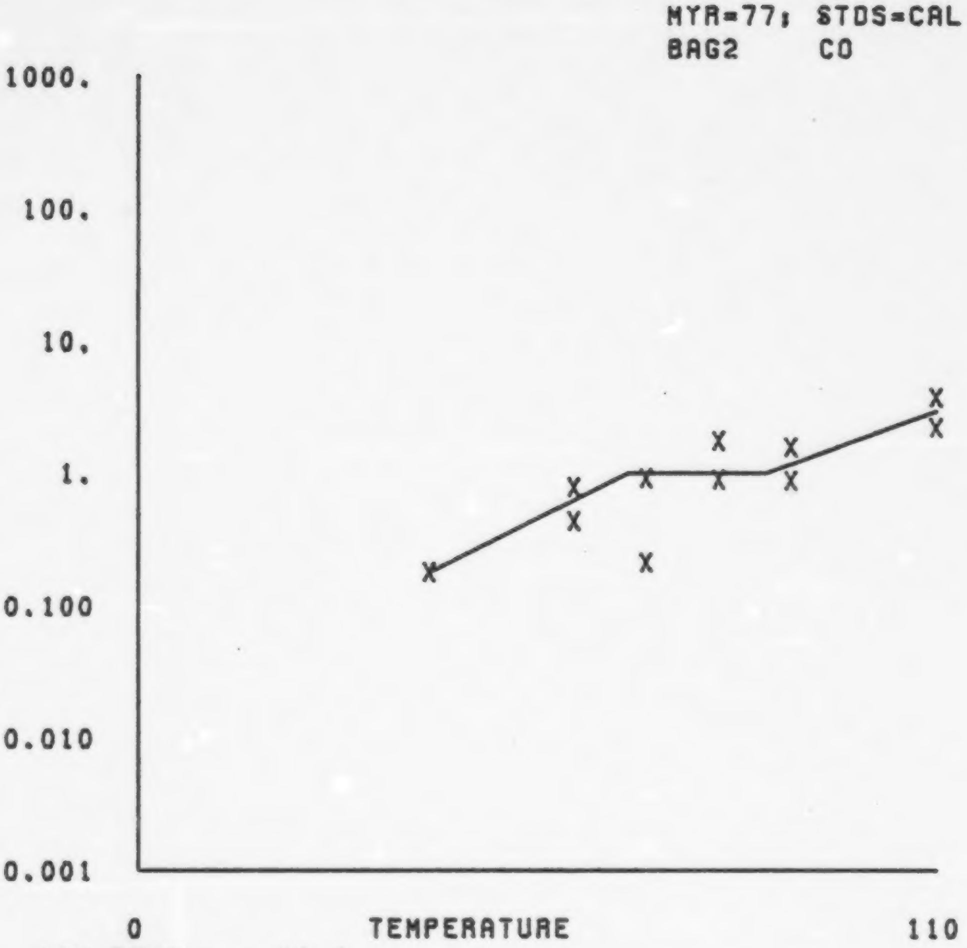
EXHIBIT 3.55

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 76FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.2112
5.0	1.1941
10.0	1.1773
15.0	1.1607
20.0	1.1443
25.0	1.1282
30.0	1.1123
35.0	1.0966
40.0	1.0812
45.0	1.0659
50.0	1.0509
55.0	1.0361
60.0	1.0215
65.0	1.0071
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	No data
95.0	" "
100.0	" "
105.0	" "
110.0	" "

EXHIBIT 3.56



```
MIN TEMP =   40.0
MAX TEMP = 110.00

N(LOW TEMP) 3               STD ERROR(LOW TEMP)    24.41%
N(FTP TEMP) 4               STD ERROR(FTP TEMP)    95.05%
N(HIGHTEMP) 4               STD ERROR(HIGHTEMP)    27.93%

     EFFECT(LOW TEMP) = EXP( 0.062939(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP( 0.045922(TEMP-86.5))
```

EXHIBIT 3.57

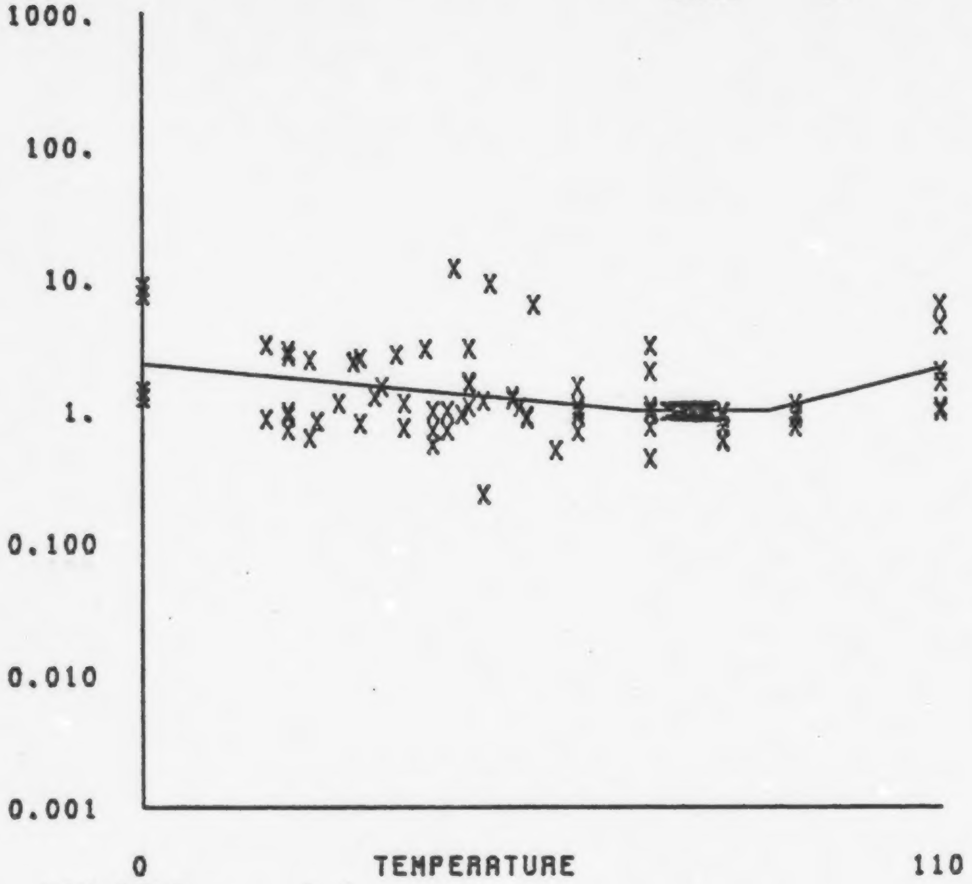
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 77CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.0143
5.0	0.0196
10.0	0.0268
15.0	0.0367
20.0	0.0503
25.0	0.0689
30.0	0.0944
35.0	0.1293
40.0	0.1771
45.0	0.2427
50.0	0.3324
55.0	0.4553
60.0	0.6237
65.0	0.8544
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1744
95.0	1.4775
100.0	1.8588
105.0	2.3386
110.0	2.9422

EXHIBIT 3.58

MYR=77; STDS=FED
BAG2 CO



MIN TEMP = 0.0
MAX TEMP = 110.00

N(LOW TEMP)	51	STD ERROR(LOW TEMP)	75.73%
N(FTP TEMP)	48	STD ERROR(FTP TEMP)	56.21%
N(HIGHTEMP)	12	STD ERROR(HIGHTEMP)	51.52%

EFFECT(LOW TEMP) = EXP(-0.012053(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(0.031591(TEMP-86.5))

EXHIBIT 3.59

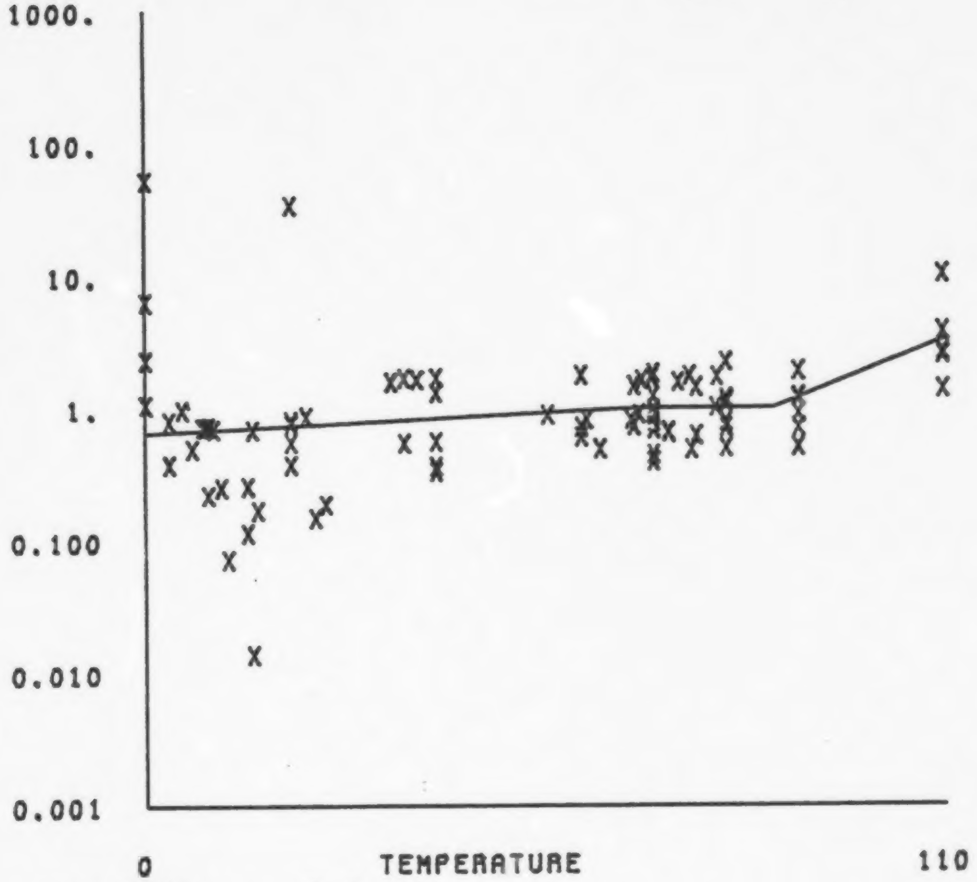
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 77FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.2560
5.0	2.1240
10.0	1.9998
15.0	1.8828
20.0	1.7727
25.0	1.6691
30.0	1.5714
35.0	1.4795
40.0	1.3930
45.0	1.3115
50.0	1.2348
55.0	1.1626
60.0	1.0946
65.0	1.0306
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1169
95.0	1.3080
100.0	1.5319
105.0	1.7940
110.0	2.1010

EXHIBIT 3.60

MYR=78; STDS=CAL
BAG2 CO



MIN TEMP = -3.8
MAX TEMP = 110.00

N(LOW TEMP)	50	STD ERROR(LOW TEMP)	128.16%
N(FTP TEMP)	28	STD ERROR(FTP TEMP)	51.72%
N(HIGHTEMP)	12	STD ERROR(HIGHTEMP)	55.08%

EFFECT(LOW TEMP) = EXP(0.006332(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(0.050040(TEMP-86.5))

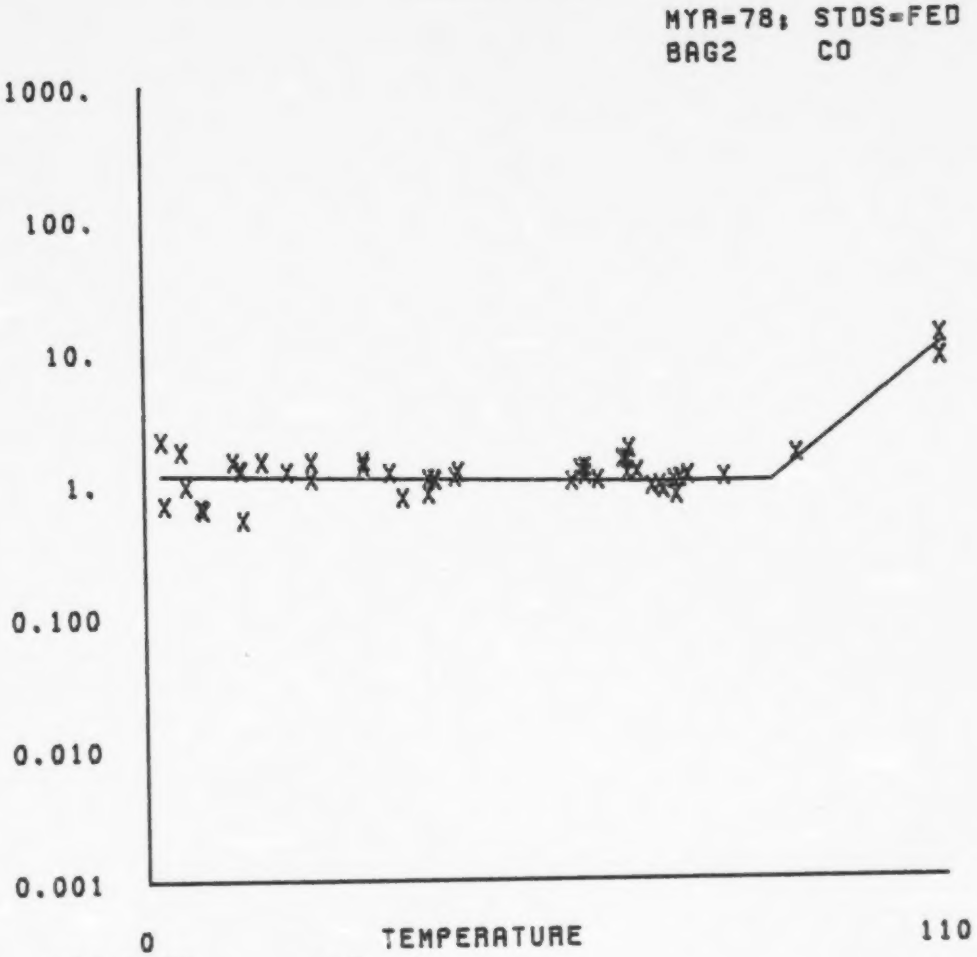
EXHIBIT 3.61

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 78CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.6522
5.0	0.6732
10.0	0.6948
15.0	0.7172
20.0	0.7403
25.0	0.7641
30.0	0.7886
35.0	0.8140
40.0	0.8402
45.0	0.8672
50.0	0.8951
55.0	0.9239
60.0	0.9536
65.0	0.9843
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1914
95.0	1.5301
100.0	1.9651
105.0	2.5237
110.0	3.2412

EXHIBIT 3.62



MIN TEMP = 2.3
MAX TEMP = 110.00

N(LOW TEMP) 34
N(FTP TEMP) 9
N(HIGHTEMP) 3

STD ERROR(LOW TEMP) 31.90%
STD ERROR(FTP TEMP) 16.70%
STD ERROR(HIGHTEMP) 17.74%

EFFECT(LOW TEMP) = EXP(-0.002313(TEMP-67.5))
EFFECT(HIGHTEMP) - EXP(0.099415(TEMP-86.5))

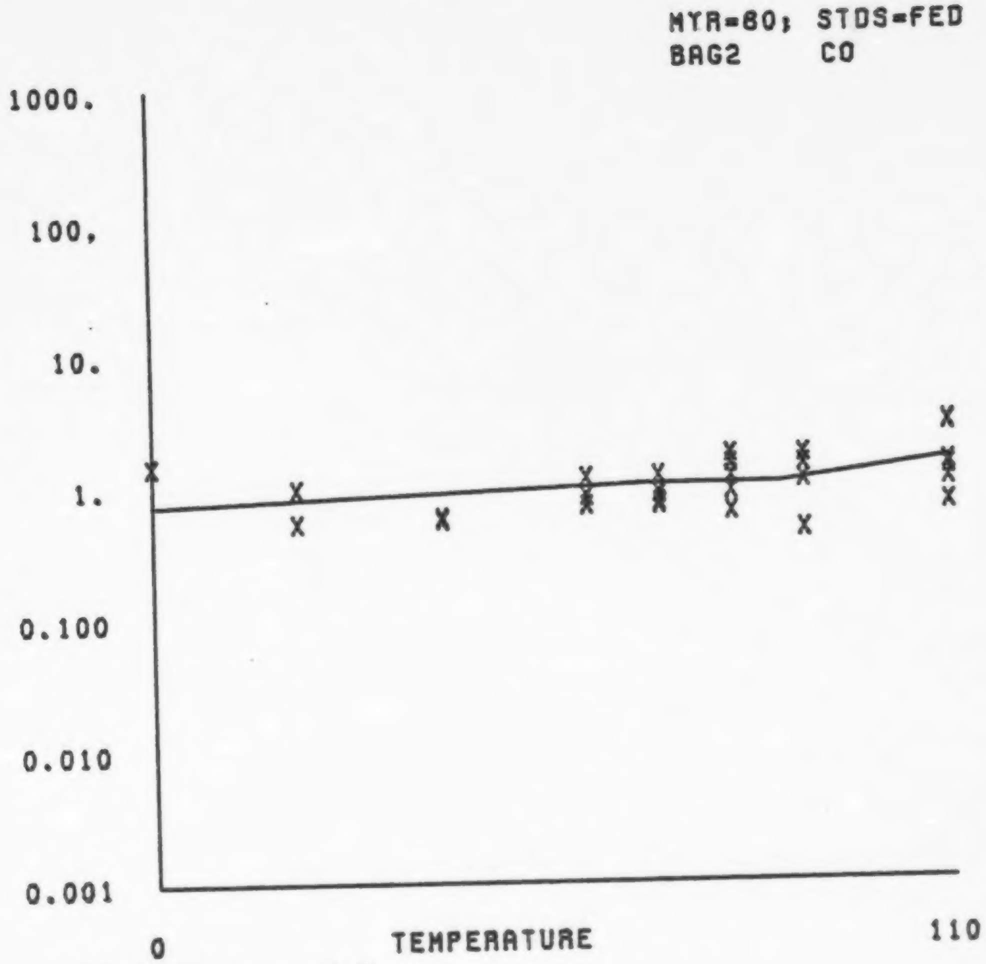
EXHIBIT 3.63

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 78FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.1690
5.0	1.1555
10.0	1.1423
15.0	1.1291
20.0	1.1161
25.0	1.1033
30.0	1.0906
35.0	1.0781
40.0	1.0657
45.0	1.0534
50.0	1.0413
55.0	1.0293
60.0	1.0175
65.0	1.0058
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.4162
95.0	2.3280
100.0	3.8271
105.0	6.2913
110.0	10.3423

EXHIBIT 3.64



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 9             STD ERROR(LOW TEMP)    39.38%
N(FTP TEMP) 11            STD ERROR(FTP TEMP)    34.61%
N(HIGHTEMP) 10            STD ERROR(HIGHTEMP)    49.99%

     EFFECT(LOW TEMP)  = EXP( 0.004674(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.016732(TEMP-86.5))
```

EXHIBIT 3.65

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF CO 80FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.7294
5.0	0.7467
10.0	0.7643
15.0	0.7824
20.0	0.8009
25.0	0.8198
30.0	0.8392
35.0	0.8591
40.0	0.8794
45.0	0.9002
50.0	0.9215
55.0	0.9433
60.0	0.9656
65.0	0.9884
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0603
95.0	1.1528
100.0	1.2534
105.0	1.3628
110.0	1.4817

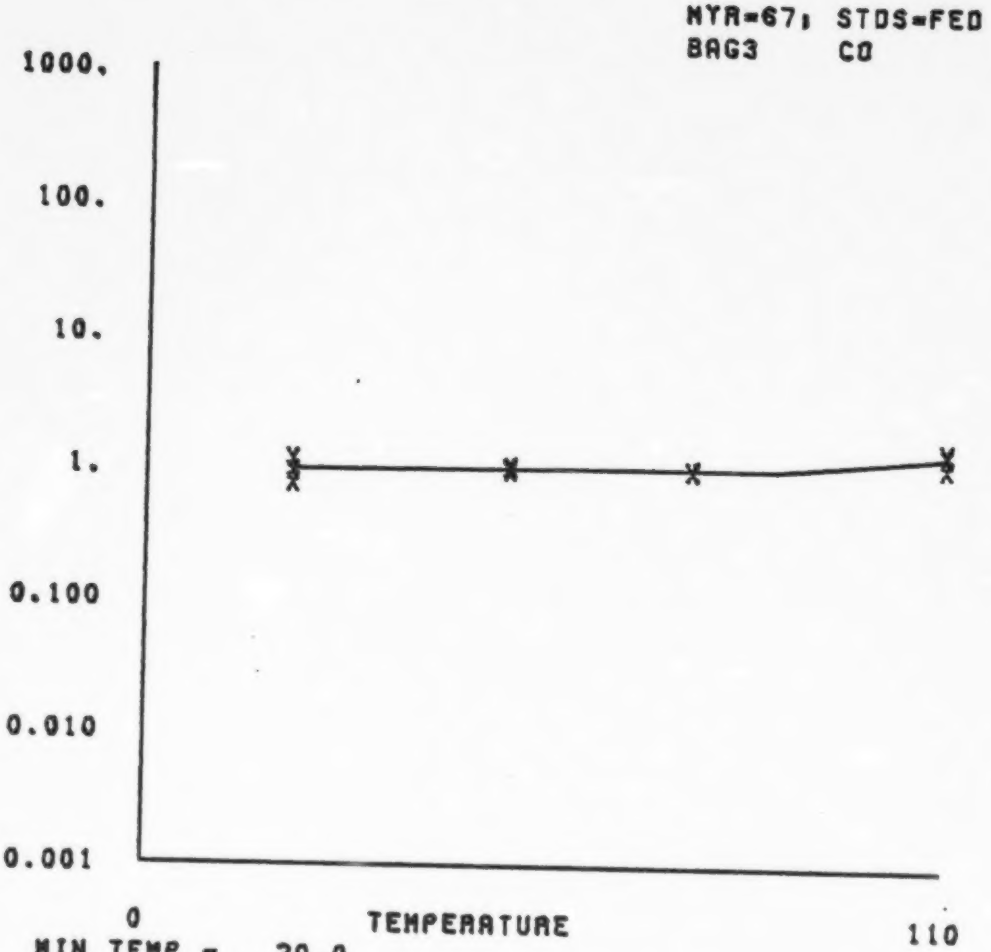
EXHIBIT 3.66: FITTED TEMPERATURE EFFECTS, HC BAG3

$$\frac{\text{EMISSIONS AT TEMPERATURE T}}{\text{EMISSIONS AT FTP TEMPERATURE}} = \begin{cases} \exp[c(T-67.5)] & \text{for T less than 67.5} \\ \exp[d(T-86.5)] & \text{for T greater than 86.5} \end{cases}$$

where exp is the exponential function and c and d are as tabled below.

MYR STDS	c	d
67FED	.00110970	.01101430
69FED	.00157494	.02517888
70FED	.00445138	.02020610
71FED	.00089329	.03138870
72FED	.00588633	.02334706
73FED	-.00256459	.01994926
74FED	.01051754	.02860412
75CAL	-.00475047	.00954565
75FED	-.00490676	.03254730
76FED	.00456253	NO DATA
77CAL	.06078482	.04648204
77FED	-.00002085	.02413589
78CAL	.00090212	.04687297
78FED	.00138281	.05016109
80FED	-.00196753	.02036447

EXHIBIT 3.67



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 6                STD ERROR(LOW TEMP)    12.55%
N(FTP TEMP) 3                STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 3                STD ERROR(HIGHTEMP)    11.98%

    EFFECT(LOW TEMP)  = EXP( 0.001110(TEMP-67.5))
    EFFECT(HIGHTEMP)  = EXP( 0.011014(TEMP-86.5))
```

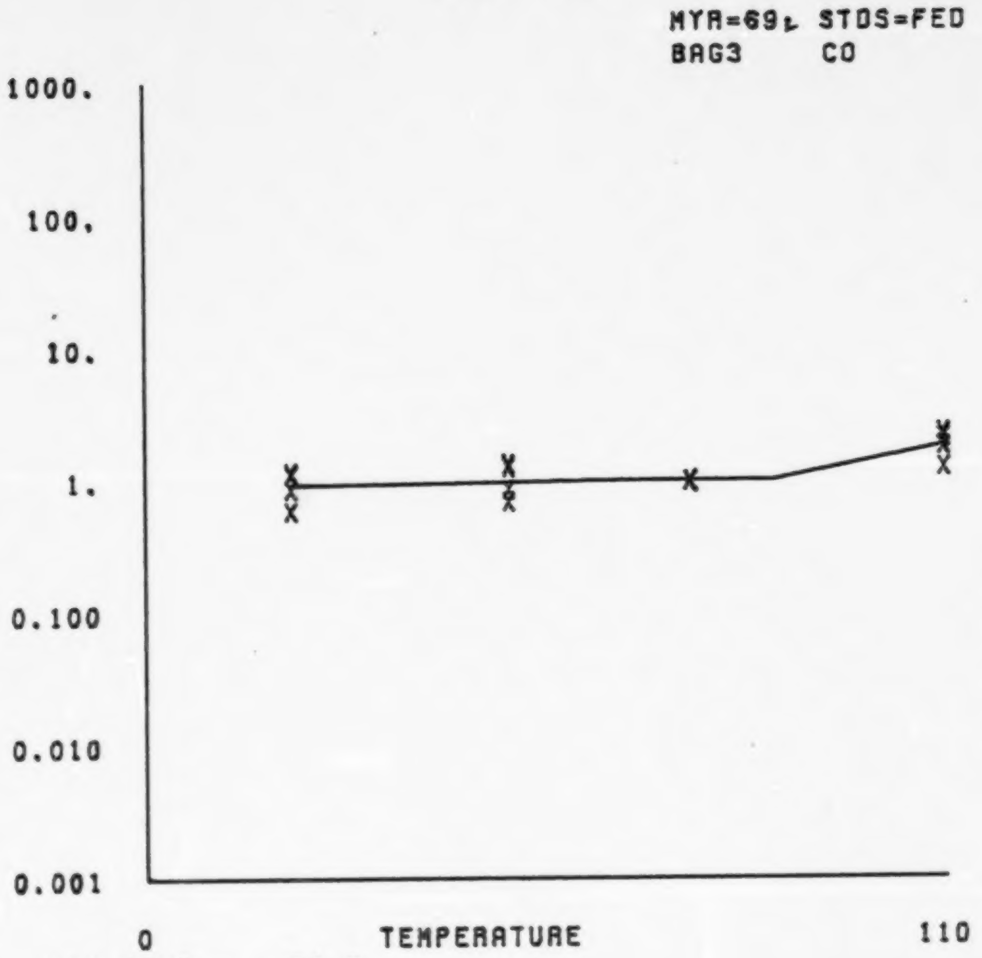
EXHIBIT 3.68

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 67FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9278
5.0	0.9330
10.0	0.9382
15.0	0.9434
20.0	0.9487
25.0	0.9539
30.0	0.9592
35.0	0.9646
40.0	0.9699
45.0	0.9753
50.0	0.9808
55.0	0.9862
60.0	0.9917
65.0	0.9972
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0393
95.0	1.0981
100.0	1.1603
105.0	1.2260
110.0	1.2954

EXHIBIT 3.69



MIN TEMP = 20.0
MAX TEMP = 110.00

N(LOW TEMP) 8 STD ERROR(LOW TEMP) 26.90%
N(FTP TEMP) 4 STD ERROR(FTP TEMP) 0.0 %
N(HIGHTEMP) 4 STD ERROR(HIGHTEMP) 23.31%

EFFECT(LOW TEMP) = EXP(0.001575(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(0.025178 (TEMP-86.5))

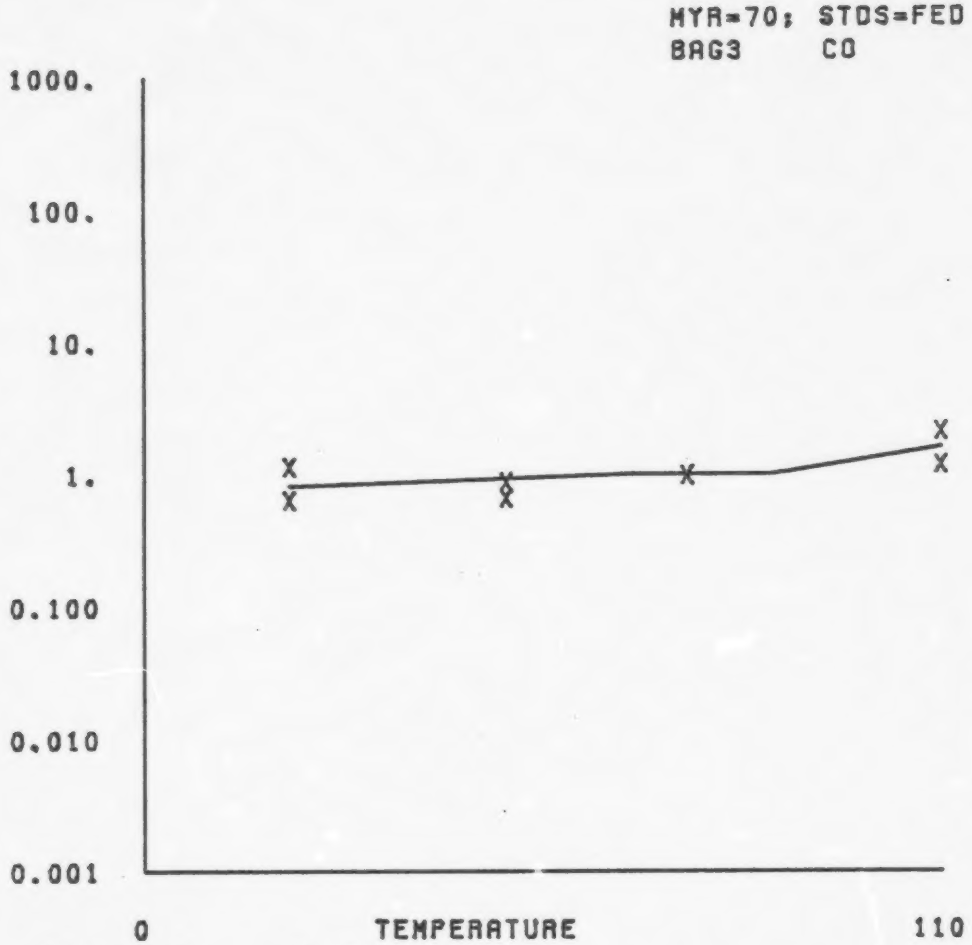
EXHIBIT 3.70

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 69FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.8991
5.0	0.9063
10.0	0.9134
15.0	0.9206
20.0	0.9279
25.0	0.9353
30.0	0.9426
35.0	0.9501
40.0	0.9576
45.0	0.9652
50.0	0.9728
55.0	0.9805
60.0	0.9883
65.0	0.9961
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0921
95.0	1.2386
100.0	1.4048
105.0	1.5933
110.0	1.8071

EXHIBIT 3.71



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 4              STD ERROR(LOW TEMP)    26.74%
N(FTP TEMP) 2              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 2              STD ERROR(HIGHTEMP)    29.15%

     EFFECT(LOW TEMP)  = EXP( 0.004451(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.020206(TEMP-86.5))
```

EXHIBIT 3.72

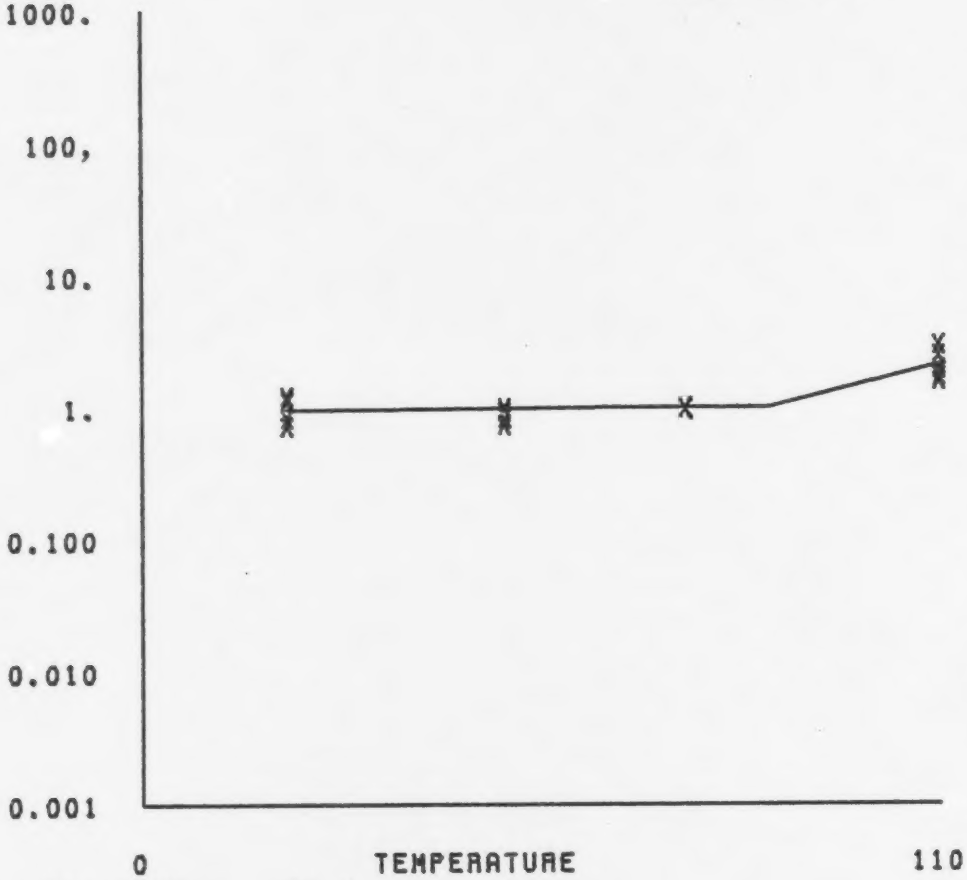
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 70FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.7405
5.0	0.7571
10.0	0.7742
15.0	0.7916
20.0	0.8094
25.0	0.8276
30.0	0.8463
35.0	0.8653
40.0	0.8848
45.0	0.9047
50.0	0.9251
55.0	0.9459
60.0	0.9672
65.0	0.9889
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0733
95.0	1.1874
100.0	1.3136
105.0	1.4533
110.0	1.6078

EXHIBIT 3.73

MYR=71; STDS=FED
BAG3 CO



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 10             STD ERROR(LOW TEMP)    18.54%
N(FTP TEMP) 5              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 5              STD ERROR(HIGHTEMP)    23.48%

     EFFECT(LOW TEMP)  = EXP( 0.000893(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.031389(TEMP-86.5))
```

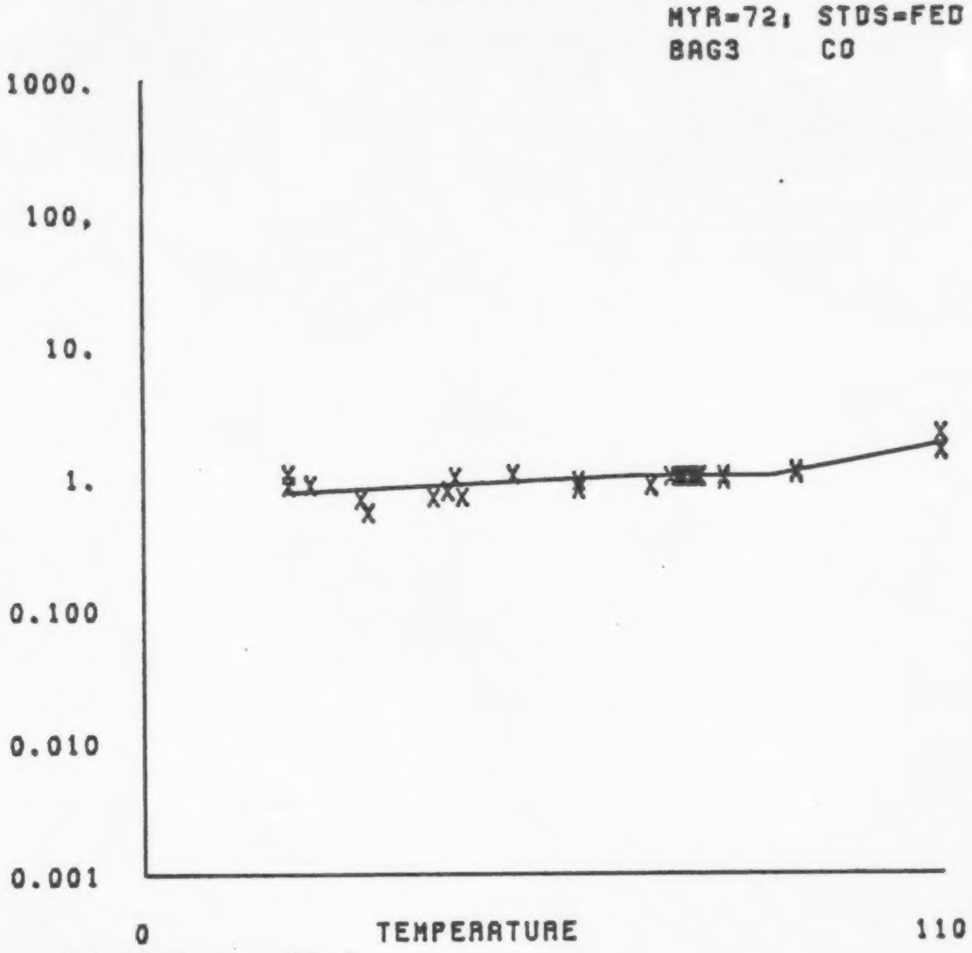
EXHIBIT 3.74

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO   71FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9415
5.0	0.9457
10.0	0.9499
15.0	0.9542
20.0	0.9585
25.0	0.9627
30.0	0.9671
35.0	0.9714
40.0	0.9757
45.0	0.9801
50.0	0.9845
55.0	0.9889
60.0	0.9933
65.0	0.9978
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1161
95.0	1.3058
100.0	1.5277
105.0	1.7873
110.0	2.0910

EXHIBIT 3.75



MIN TEMP = 20.0
MAX TEMP = 110.00

N(LOW TEMP) 12
N(FTP TEMP) 12
N(HIGHTEMP) 5

STD ERROR(LOW TEMP) 20.17%
STD ERROR(FTP TEMP) 12.75%
STD ERROR(HIGHTEMP) 11.10%

EFFECT(LOW TEMP) = EXP(0.005886(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(0.023347(TEMP-88.5))

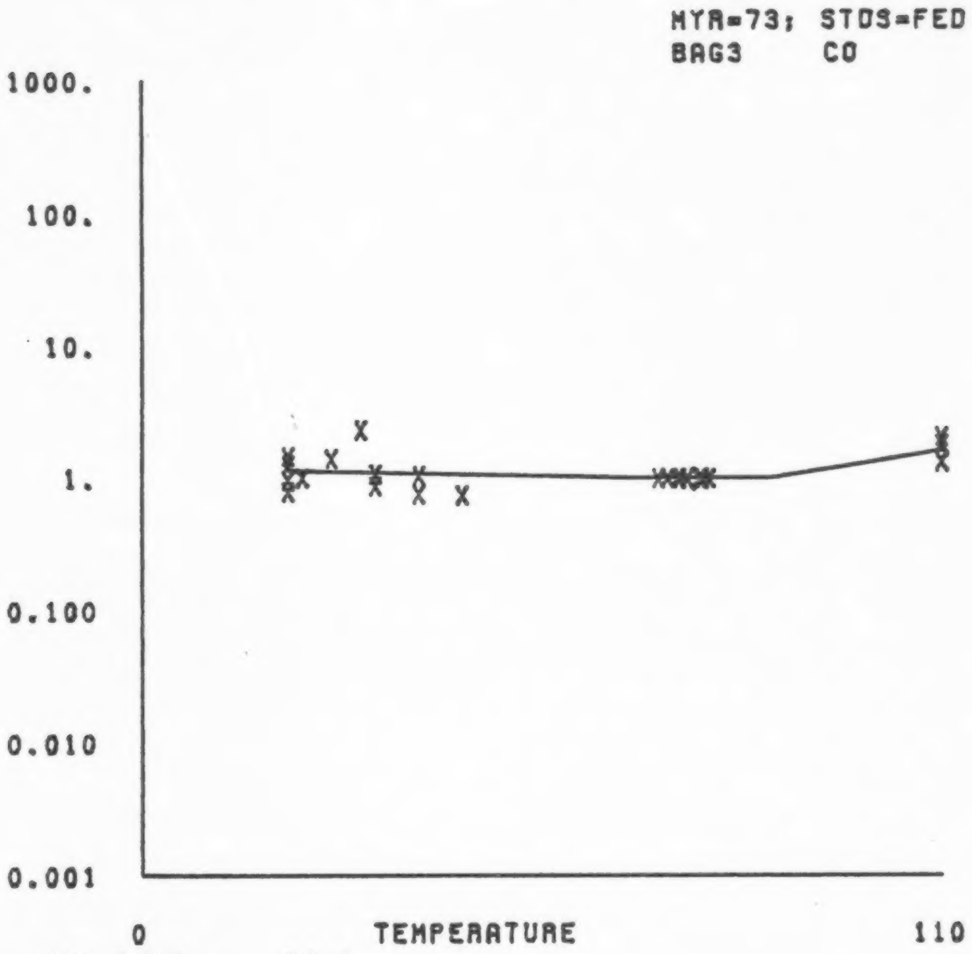
EXHIBIT 3.76

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO   72FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.6721
5.0	0.6922
10.0	0.7129
15.0	0.7342
20.0	0.7561
25.0	0.7787
30.0	0.8019
35.0	0.8259
40.0	0.8505
45.0	0.8760
50.0	0.9021
55.0	0.9291
60.0	0.9568
65.0	0.9854
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0851
95.0	1.2195
100.0	1.3705
105.0	1.5402
110.0	1.7309

EXHIBIT 3.77



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 12              STD ERROR(LOW TEMP)    31.05%
N(FTP TEMP) 12              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 4               STD ERROR(HIGHTEMP)    19.19%

     EFFECT(LOW TEMP)  = EXP(-0.002565(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.019949(TEMP-86.5))
```

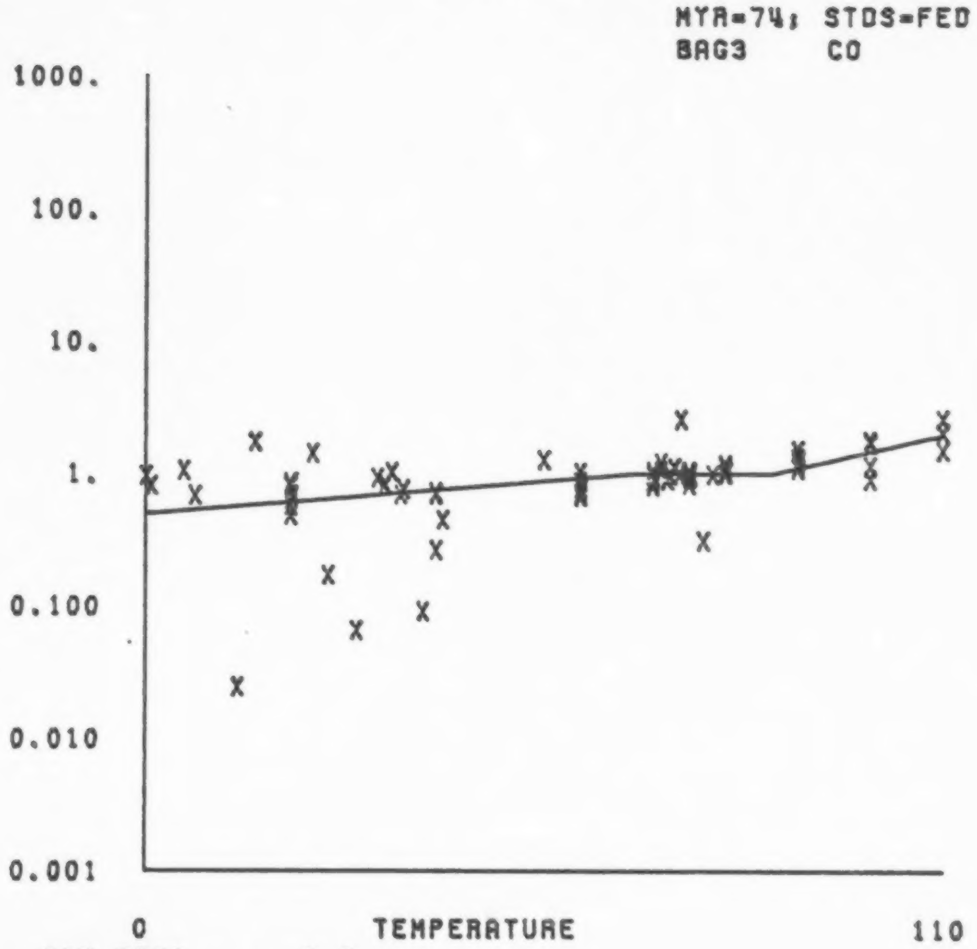
EXHIBIT 3.78

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 73FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.1890
5.0	1.1738
10.0	1.1589
15.0	1.1441
20.0	1.1295
25.0	1.1152
30.0	1.1009
35.0	1.0869
40.0	1.0731
45.0	1.0594
50.0	1.0459
55.0	1.0326
60.0	1.0194
65.0	1.0064
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0723
95.0	1.1848
100.0	1.3091
105.0	1.4464
110.0	1.5981

EXHIBIT 3.79



MIN TEMP = -6.9
MAX TEMP = 110.00

N(LOW TEMP)	33	STD ERROR(LOW TEMP)	92.41%
N(FTP TEMP)	27	STD ERROR(FTP TEMP)	42.37%
N(HIGHTEMP)	12	STD ERROR(HIGHTEMP)	23.62%

EFFECT(LOW TEMP) = EXP(0.010518(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(0.028604(TEMP-86.5))

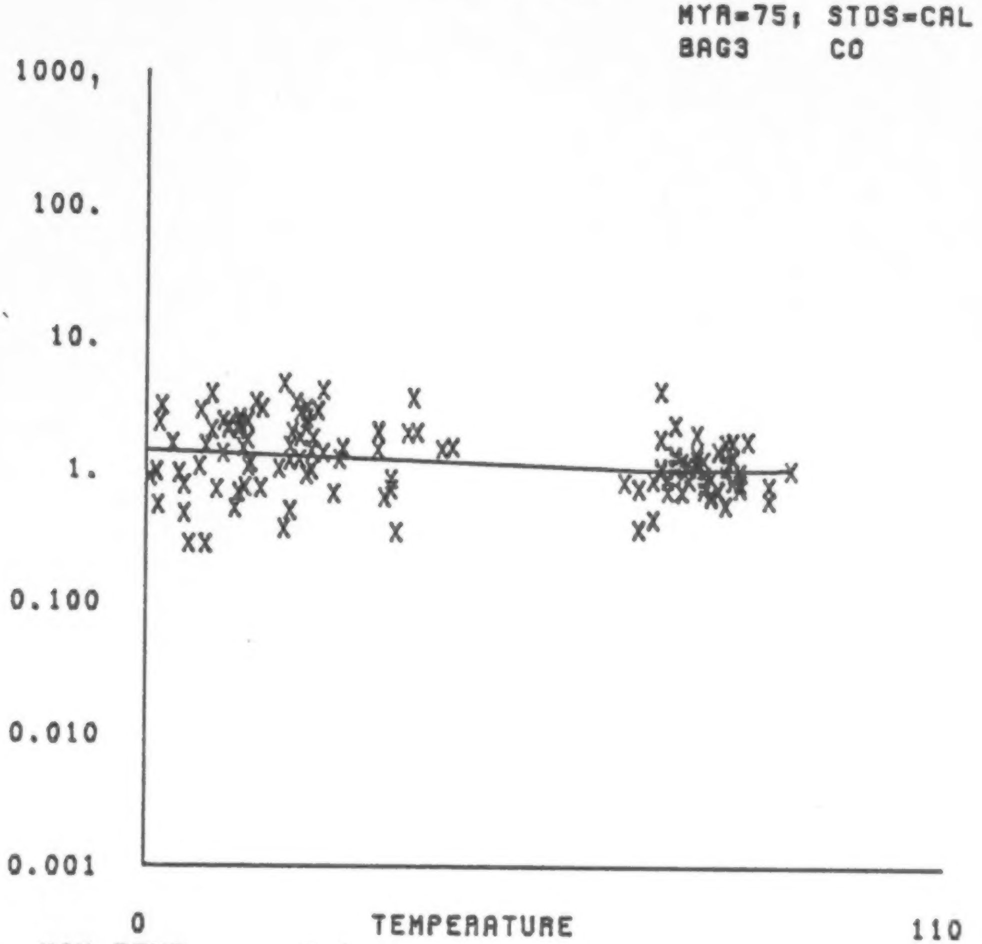
EXHIBIT 3.80

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 74FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.4917
5.0	0.5182
10.0	0.5462
15.0	0.5757
20.0	0.6068
25.0	0.6395
30.0	0.6741
35.0	0.7105
40.0	0.7488
45.0	0.7893
50.0	0.8319
55.0	0.8768
60.0	0.9241
65.0	0.9740
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1053
95.0	1.2752
100.0	1.4713
105.0	1.6975
110.0	1.9585

EXHIBIT 3.81



```
MIN TEMP =    -7.1
MAX TEMP =   89.00

N(LOW TEMP) 84              STD ERROR(LOW TEMP)     65.37%
N(FTP TEMP) 49              STD ERROR(FTP TEMP)     43.18%
N(HIGHTEMP) 1               STD ERROR(HIGHTEMP)      0.0 %

     EFFECT(LOW TEMP)  = EXP(-0.004750(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.009548(TEMP-88.5))
```

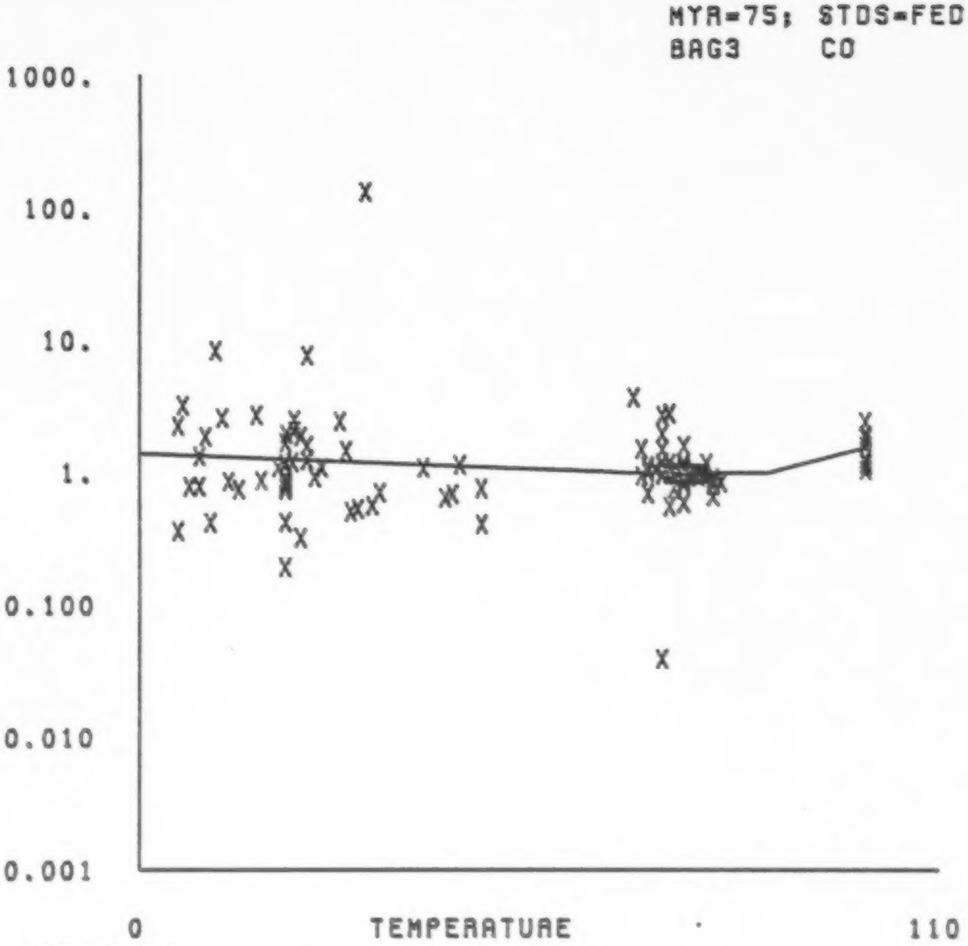
EXHIBIT 3.82

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 75CAL

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.3780
5.0	1.3457
10.0	1.3141
15.0	1.2833
20.0	1.2531
25.0	1.2237
30.0	1.1950
35.0	1.1669
40.0	1.1396
45.0	1.1128
50.0	1.0867
55.0	1.0612
60.0	1.0363
65.0	1.0119
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0340
95.0	1.0845
100.0	1.1375
105.0	1.1931
110.0	1.2515

EXHIBIT 3.83



```
MIN TEMP =    -5.4
MAX TEMP = 100.00

N(LOW TEMP) 53              STD ERROR(LOW TEMP)     96.73%
N(FTP TEMP) 58              STD ERROR(FTP TEMP)     74.49%
N(HIGHTEMP) 9               STD ERROR(HIGHTEMP)     27.06%

     EFFECT(LOW TEMP)  = EXP(-0.004907(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP( 0.032547(TEMP-86.5))
```

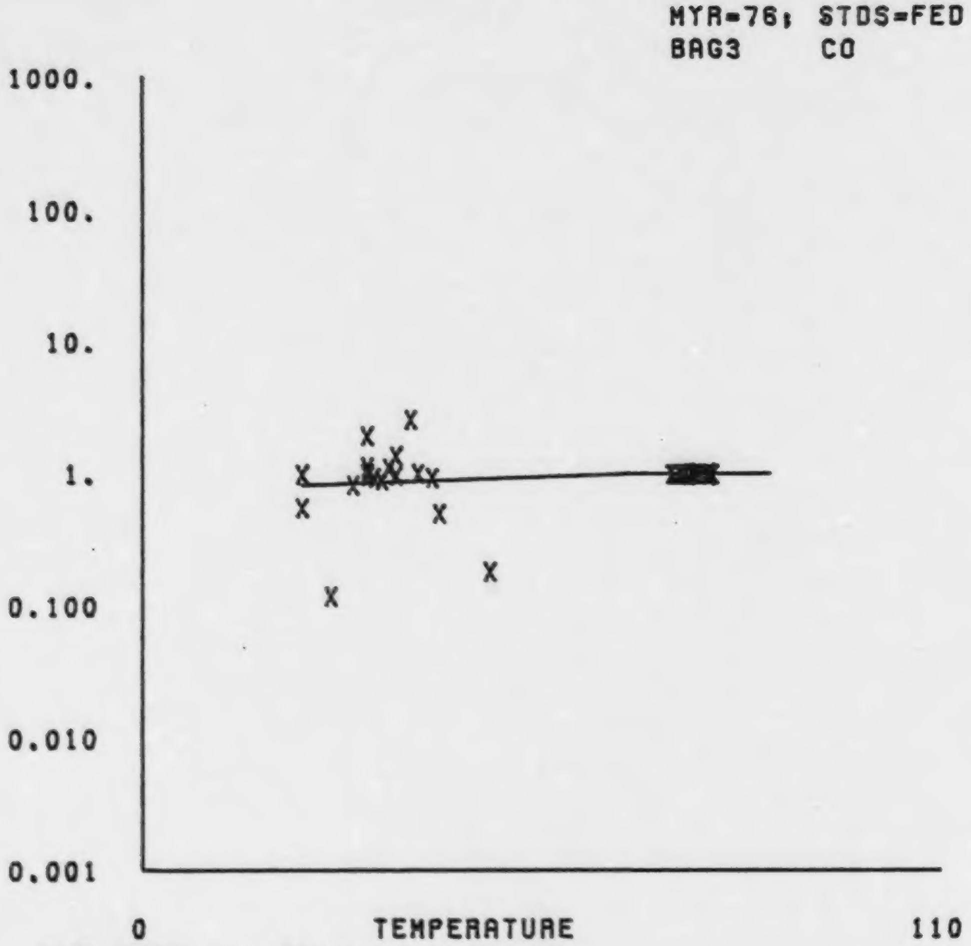
EXHIBIT 3.84

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 75FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.3926
5.0	1.3589
10.0	1.3260
15.0	1.2938
20.0	1.2625
25.0	1.2319
30.0	1.2020
35.0	1.1729
40.0	1.1445
45.0	1.1167
50.0	1.0897
55.0	1.0633
60.0	1.0375
65.0	1.0123
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1207
95.0	1.3187
100.0	1.5518
105.0	1.8260
110.0	2.1487

EXHIBIT 3.85



```
MIN TEMP =   22.0
MAX TEMP =   78.70

N(LOW TEMP)  19              STD ERROR(LOW TEMP)    69.71%
N(FTP TEMP)  19              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP)  0               STD ERROR(HIGHTEMP)     0.0 %

        EFFECT(LOW TEMP) = EXP( 0.004583(TEMP-67.5))
```

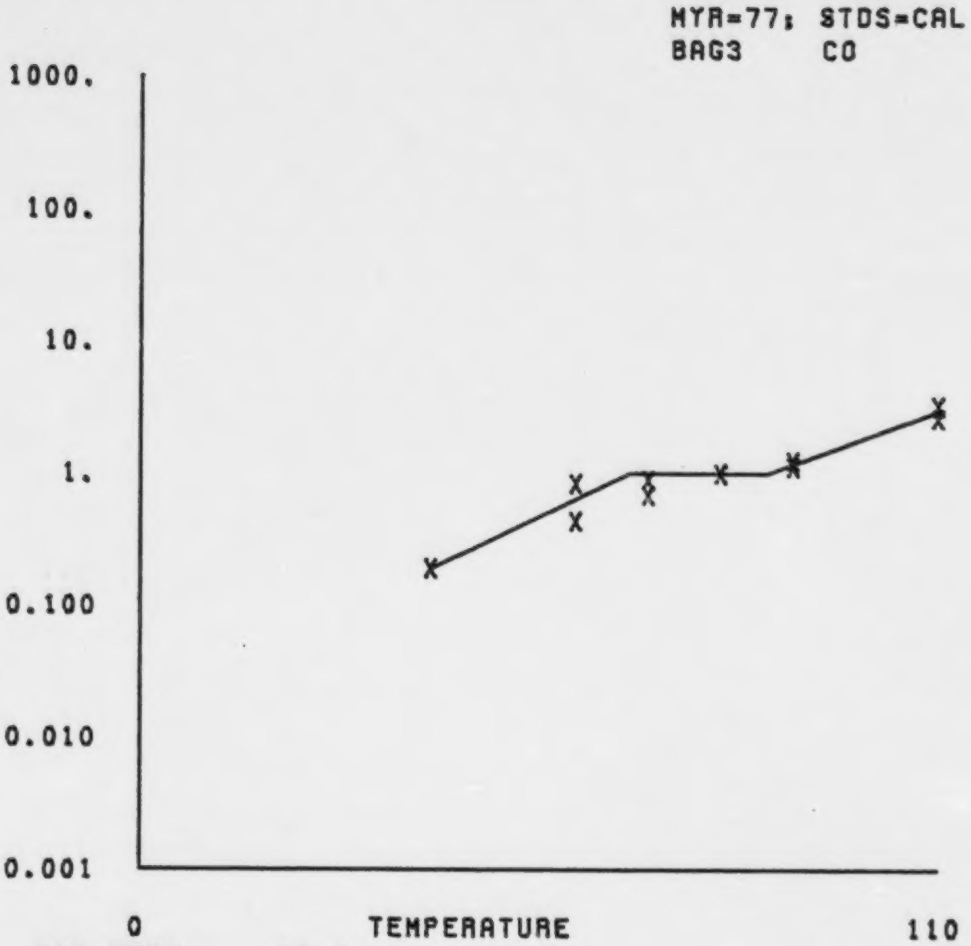
EXHIBIT 3.86

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 76FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.7349
5.0	0.7519
10.0	0.7692
15.0	0.7870
20.0	0.8052
25.0	0.8237
30.0	0.8427
35.0	0.8622
40.0	0.8821
45.0	0.9024
50.0	0.9233
55.0	0.9446
60.0	0.9664
65.0	0.9887
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	No data
95.0	" "
100.0	" "
105.0	" "
110.0	" "

EXHIBIT 3.87



```
MIN TEMP =   40.0
MAX TEMP = 110.00

N(LOW TEMP) 3                STD ERROR(LOW TEMP)    26.92%
N(FTP TEMP) 4                STD ERROR(FTP TEMP)    22.05%
N(HIGHTEMP) 4                STD ERROR(HIGHTEMP)     9.02%

     EFFECT(LOW TEMP) = EXP( 0.060785(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP( 0.046482(TEMP-86.5))
```

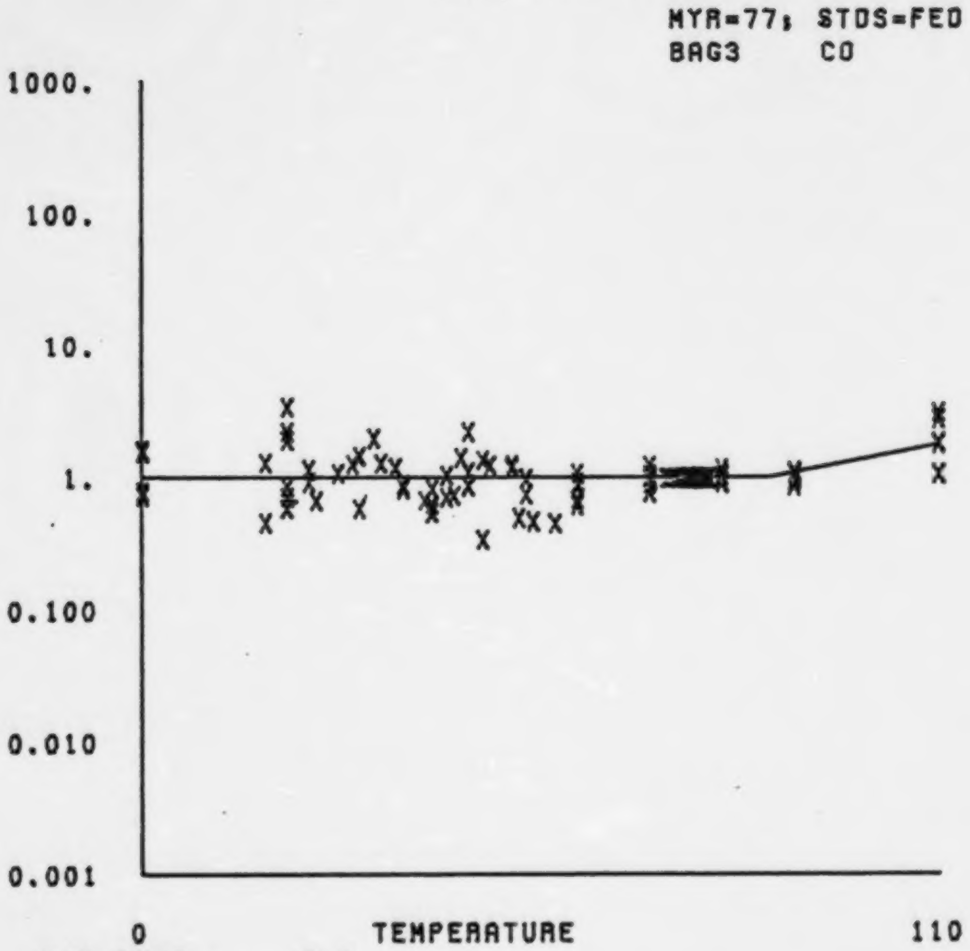
EXHIBIT 3.88

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 77CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.0165
5.0	0.0224
10.0	0.0303
15.0	0.0411
20.0	0.0557
25.0	0.0755
30.0	0.1023
35.0	0.1387
40.0	0.1879
45.0	0.2547
50.0	0.3452
55.0	0.4678
60.0	0.6339
65.0	0.8590
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1767
95.0	1.4845
100.0	1.8729
105.0	2.3630
110.0	2.9812

EXHIBIT 3.89



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 52          STD ERROR(LOW TEMP)   46.79%
N(FTP TEMP) 48          STD ERROR(FTP TEMP)   15.31%
N(HIGHTEMP) 12          STD ERROR(HIGHTEMP)   30.68%

      EFFECT(LOW TEMP) = EXP(-0.000021(TEMP-67.5))
      EFFECT(HIGHTEMP) = EXP( 0.024136(TEMP-86.5))
```

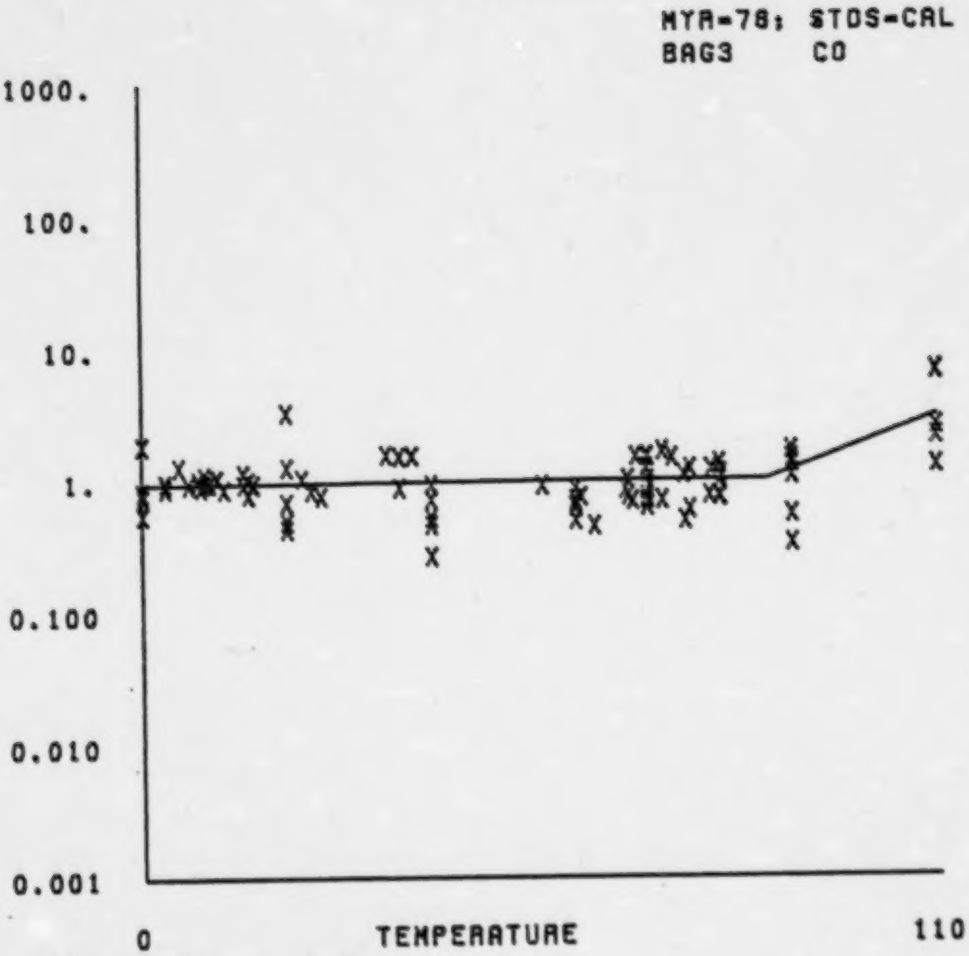
EXHIBIT 3.90

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 77FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0014
5.0	1.0013
10.0	1.0012
15.0	1.0011
20.0	1.0010
25.0	1.0009
30.0	1.0008
35.0	1.0007
40.0	1.0006
45.0	1.0005
50.0	1.0004
55.0	1.0003
60.0	1.0002
65.0	1.0001
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0881
95.0	1.2277
100.0	1.3852
105.0	1.5629
110.0	1.7633

EXHIBIT 3.91



MIN TEMP = -3.8
MAX TEMP = 110.00

N(LOW TEMP) 50
N(FTP TEMP) 28
N(HIGHTEMP) 12

STD ERROR(LOW TEMP) 42.51%
STD ERROR(FTP TEMP) 34.44%
STD ERROR(HIGHTEMP) 61.08%

EFFECT(LOW TEMP) = EXP(0.000902(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(0.046873(TEMP-88.5))

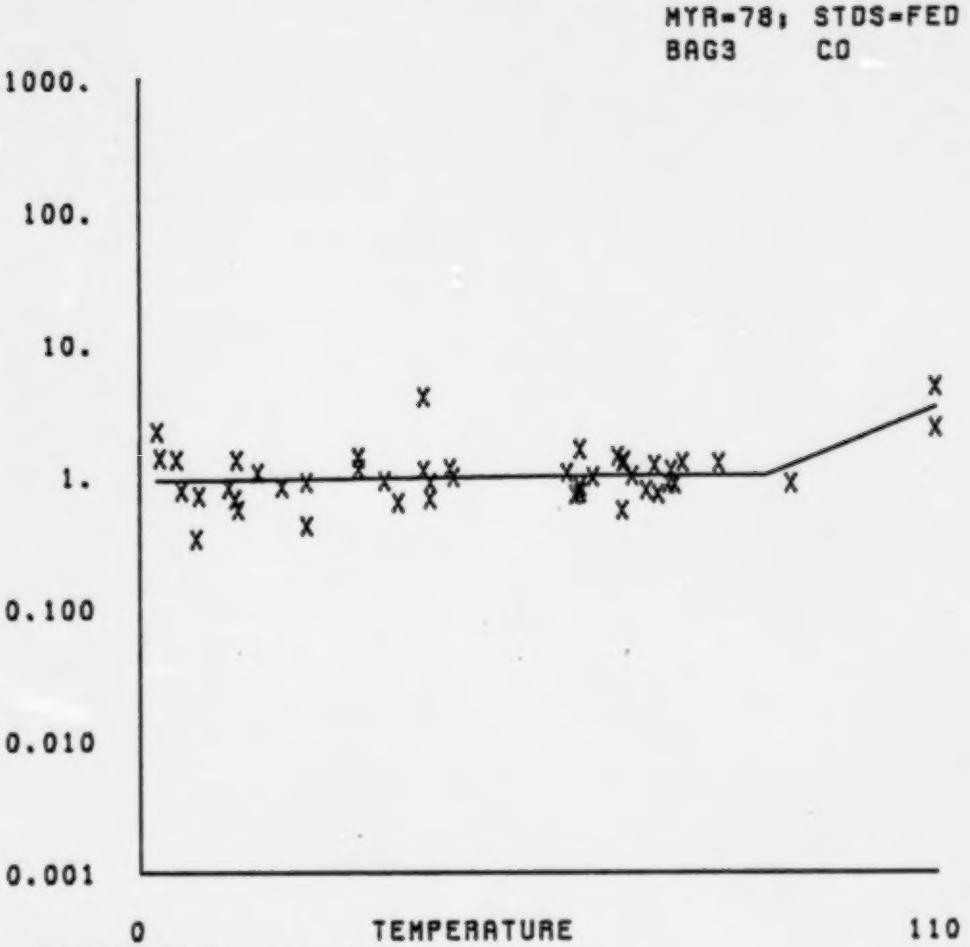
EXHIBIT 3.92

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 78CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9409
5.0	0.9452
10.0	0.9495
15.0	0.9537
20.0	0.9581
25.0	0.9624
30.0	0.9667
35.0	0.9711
40.0	0.9755
45.0	0.9799
50.0	0.9843
55.0	0.9888
60.0	0.9933
65.0	0.9977
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1783
95.0	1.4895
100.0	1.8828
105.0	2.3801
110.0	3.0087

EXHIBIT 3.93



```
MIN TEMP =    2.3
MAX TEMP = 110.00

N(LOW TEMP) 34              STD ERROR(LOW TEMP)    45.27%
N(FTP TEMP) 9               STD ERROR(FTP TEMP)    26.52%
N(HIGHTEMP) 3               STD ERROR(HIGHTEMP)    33.93%

     EFFECT(LOW TEMP) = EXP( 0.001383(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP( 0.050161(TEMP-86.5))
```

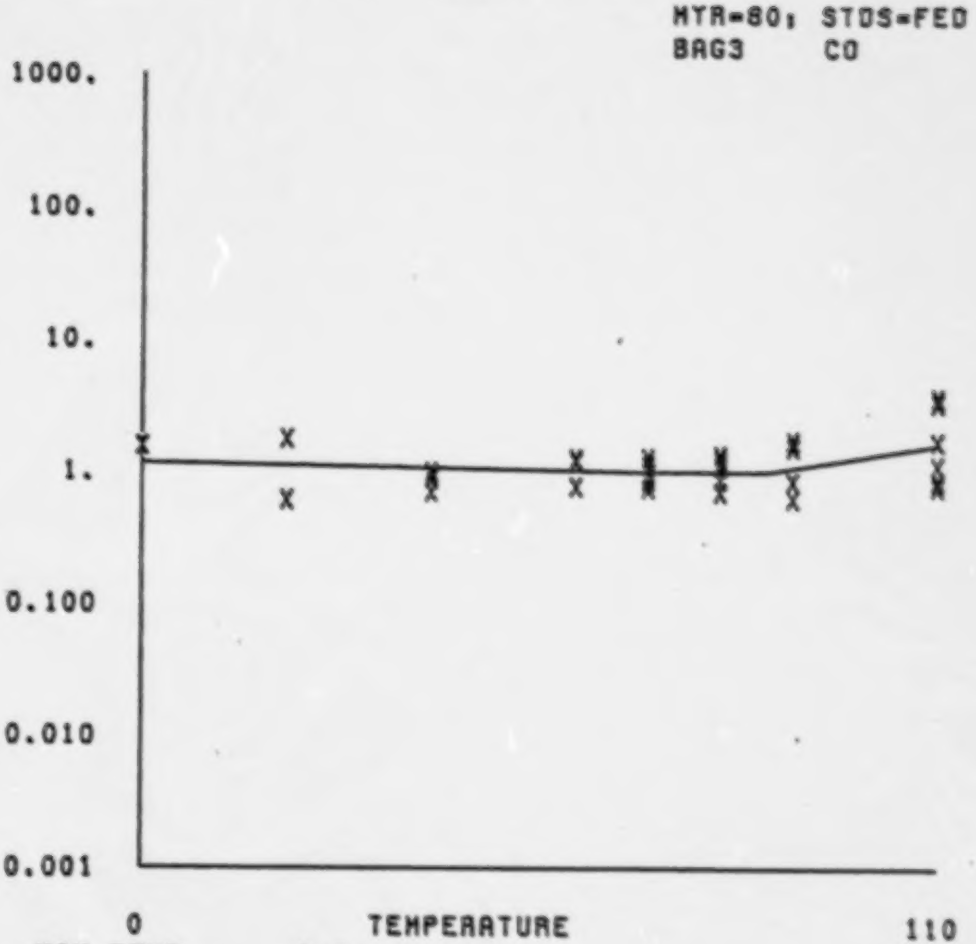
EXHIBIT 3.94

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 78FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9109
5.0	0.9172
10.0	0.9236
15.0	0.9300
20.0	0.9364
25.0	0.9429
30.0	0.9495
35.0	0.9561
40.0	0.9627
45.0	0.9694
50.0	0.9761
55.0	0.9829
60.0	0.9897
65.0	0.9965
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.1919
95.0	1.5317
100.0	1.9683
105.0	2.5294
110.0	3.2504

EXHIBIT 3.95



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 9            STD ERROR(LOW TEMP)    33.80%
N(FTP TEMP) 11           STD ERROR(FTP TEMP)    23.85%
N(HIGHTEMP) 10           STD ERROR(HIGHTEMP)    54.71%

     EFFECT(LOW TEMP) = EXP(-0.001988(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP( 0.020364(TEMP-86.5))
```

EXHIBIT 3.96

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF CO 80FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.1420
5.0	1.1309
10.0	1.1198
15.0	1.1088
20.0	1.0980
25.0	1.0872
30.0	1.0766
35.0	1.0660
40.0	1.0556
45.0	1.0453
50.0	1.0350
55.0	1.0249
60.0	1.0149
65.0	1.0049
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0739
95.0	1.1890
100.0	1.3164
105.0	1.4575
110.0	1.6138

4.0 THE EFFECT OF TEMPERATURE ON OXIDES OF NITROGEN EMISSIONS

Measurements of NOx emissions of more than 100 vehicles at various temperatures were available in the data sources described in appendix B. Because the desired form of the ultimate correction formulae for emissions concerned ratios of emissions at various temperatures, the first step in the analysis of the data was to take logarithms of all emissions data[1]. Since it was desired to separate the effects of temperature on emissions from any confounding effect related to the fact that vehicles had significantly different absolute emission levels, the second step in the preparation of the data for analysis was the reduction of the original emissions data, given in measured grams per mile of emissions for each of the three bags of the Federal Test Procedure, to temperature effect data. To do this, the mean log emissions of each vehicle at FTP temperature were estimated by the mean of the relevant measured emissions. This estimate of the FTP-temperature log emissions was then subtracted from each test measurement in the data for this vehicle to derive logarithmic temperature effect data for each test. Each such datum is essentially an estimate of the logarithm of the ratio of the emissions under the actual test conditions to those under FTP temperature conditions.

---

[1] In some of the data sets, mileage adjustments were made before this step, as described in appendix B.

4.1 THE EXISTENCE AND NATURE OF TEMPERATURE EFFECTS

Prior to fitting explicit temperature-dependency formulae, the data for each FTP bag was examined to determine whether temperature effects existed. To do this, the data was divided into three groups, one representing measurements at temperatures below the FTP range, one representing measurements in the FTP range, and one representing measurements at temperatures above the FTP temperature range. If no temperature effect was present, the distribution of the measured temperature effect in each of the low-temperature and high-temperature groups could reasonably be expected to be identical, and to have mean and median zero or very nearly zero. Exhibits 4.1 through 4.3 show the actual mean, standard deviation, minimum, quartiles, and maximum of the data in each of the two temperature groups for each of the two bags.

Inspection of the data indicates the presence of apparent temperature effects in all bags. To confirm this impression, formal statistical tests were applied to verify the presence of temperature effects in all three bags. Kolmogorov-Smirnov tests were used to test whether the high-temperature and low-temperature groups had statistically significantly different distributions. In all three bags, the distributions were found to be significantly different (at better than the .001 level), confirming the existence of temperature effects in all bags. As described in appendix A, all of the

EXHIBIT 4.1: BAG 1 NOx TEMPERATURE EFFECTS

	LOW TEMP.	HIGH TEMP.
MEAN TEMPERATURE EFFECT	.08107	-.24569
STANDARD DEVIATION	.48639	.37022
MINIMUM TEMPERATURE EFFECT	-1.2429	-1.1609
FIRST QUARTILE	-.18503	-.47887
MEDIAN	.05203	-.21868
THIRD QUARTILE	.31656	.02757
MAXIMUM TEMPERATURE EFFECT	1.7466	.59109
NUMBER OF MEASUREMENTS	490	143

EXHIBIT 4.2: BAG 2 NOx TEMPERATURE EFFECTS

	LOW TEMP.	HIGH TEMP.
MEAN TEMPERATURE EFFECT	.10253	-.19198
STANDARD DEVIATION	.40499	.41478
MINIMUM TEMPERATURE EFFECT	-3.1042	-1.6872
FIRST QUARTILE	-.10006	-.37152
MEDIAN	.13294	-.14518
THIRD QUARTILE	.33587	.02878
MAXIMUM TEMPERATURE EFFECT	1.3962	.75710
NUMBER OF MEASUREMENTS	490	143

EXHIBIT 4.3: BAG 3 NOx TEMPERATURE EFFECTS

	LOW TEMP.	HIGH TEMP.
MEAN TEMPERATURE EFFECT	.09582	-.23733
STANDARD DEVIATION	.33751	.36081
MINIMUM TEMPERATURE EFFECT	-1.3799	-1.4288
FIRST QUARTILE	-.09142	-.35442
MEDIAN	.12150	-.17829
THIRD QUARTILE	.31326	.01447
MAXIMUM TEMPERATURE EFFECT	1.0079	.51218
NUMBER OF MEASUREMENTS	490	143

statistical tests used were non-parametric, so that no assumptions were required concerning the actual distribution of the measured temperature effects. On the basis of this analysis, it was found necessary to fit temperature effects equations to each of the three bags. From the data, it was expected that the equations would show increases in emissions at low temperatures for all three bags and decreases in emissions at high temperatures for all three bags.

4.2 EQUATIONS DESCRIBING TEMPERATURE DEPENDENCE

As described in appendix A, the data was found to show not only temperature effects, but also effects of model year and type of standards (California or 49-state Federal standards). As noted there, the data also showed an effect due to data source, but examination proved that the effects of model year and standards on temperature dependence remained even after allowance for the data source effect. Accordingly, separate fits were made for each model-year-standards combination in the data. As described in appendix A, the fits were made by least-squares methods to separate linear forms (in the temperature effects data - equivalent to exponential forms in actual emissions) for the low-temperature and high-temperature ranges. As with HC and CO emissions, the NOx temperature effects for the individual standards-year combinations generally conformed to the pattern expected from the aggregate analysis described above.

These fitted equations, together with the data to which they were fitted, are shown in semi-log scale plots and tabular form in exhibits 4.04 through 4.96. The plots also give the minimum and maximum temperatures at which measurements were actually available for the various model-year-standards combinations. Data points for measurements below 0° are omitted from the plots and tables. The tables give values of the temperature effect equations at 5° intervals from 0° to 110°.

EXHIBIT 4.04: FITTED TEMPERATURE EFFECTS, NO_x BAG1

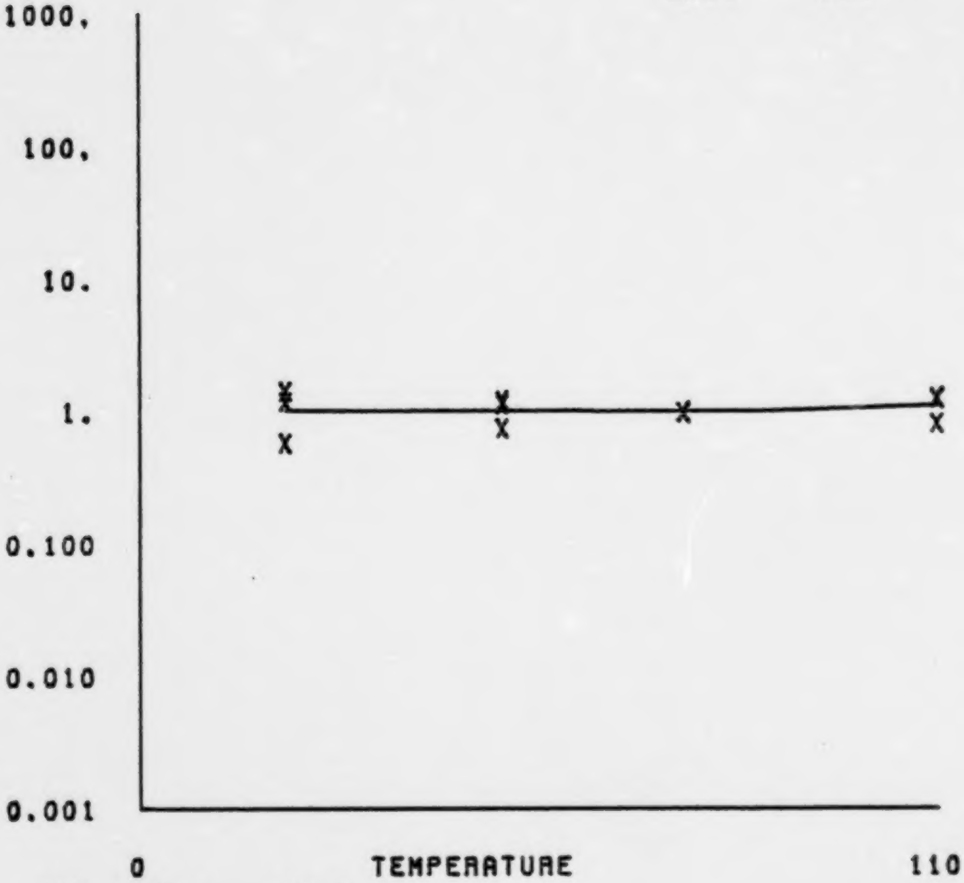
$$\frac{\text{EMISSIONS AT TEMPERATURE T}}{\text{EMISSIONS AT FTP TEMPERATURE}} = \begin{cases} \exp[c(T-67.5)] & \text{for T less than 67.5} \\ \exp[d(T-86.5)] & \text{for T greater than 86.5} \end{cases}$$

where exp is the exponential function and c and d are as tabled below.

MYR STDS	c	d
67FED	-.00016897	.00388409
69FED	-.00024573	.00854727
70FED	-.00570229	-.00202284
71FED	.00135841	.00259589
72FED	.00045525	-.01516005
73FED	.00104307	-.00792298
74FED	.00496842	-.02240865
75CAL	-.00260300	-.09986141
75FED	.00632774	-.00714202
76FED	-.01212185	NO DATA
77CAL	-.03051290	-.02566048
77FED	-.01085119	-.02456291
78CAL	-.00132599	-.03034681
78FED	-.00052566	-.03131737
80FED	-.00211344	-.03550677

EXHIBIT 4.05

MYR=67; STDS=FED
BAG1 NOX



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 6              STD ERROR(LOW TEMP)    31.33%
N(FTP TEMP) 3              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 3              STD ERROR(HIGHTEMP)    20.61%

      EFFECT(LOW TEMP) = EXP(-0.000169(TEMP-67.5))
      EFFECT(HIGHTEMP) = EXP( 0.003884 (TEMP-88.5))
```

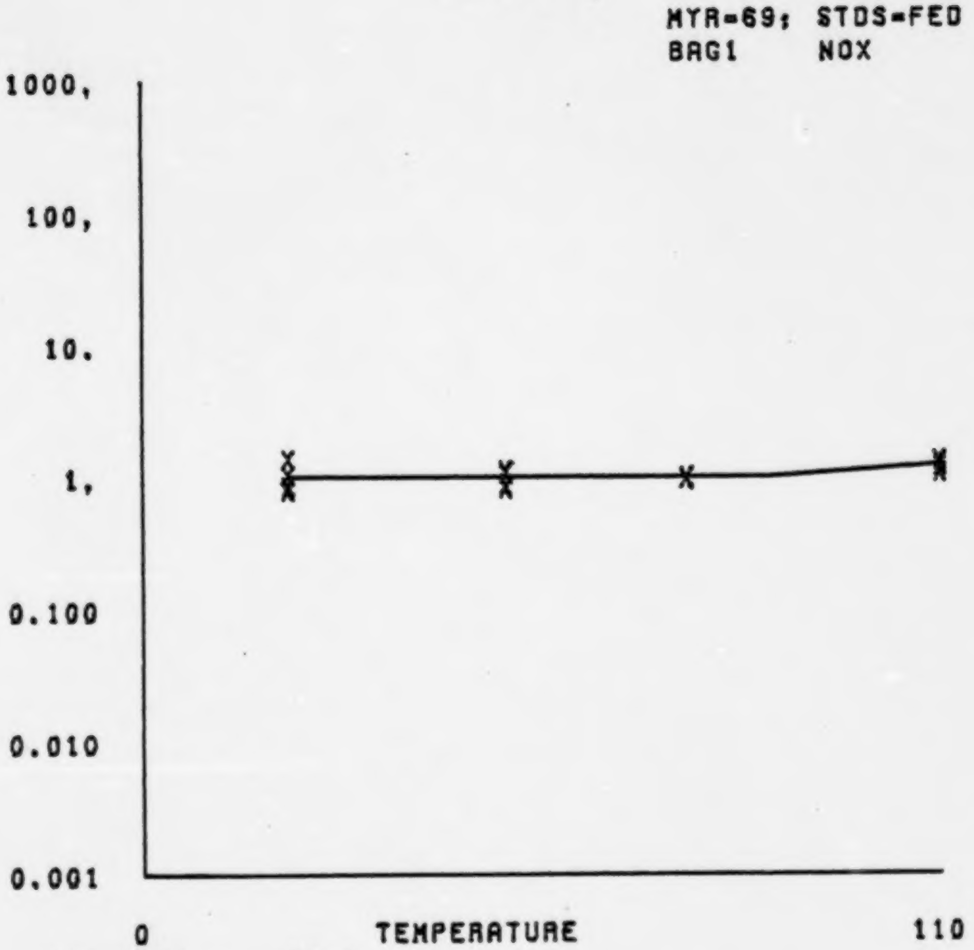
EXHIBIT 4.06

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 67FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0115
5.0	1.0106
10.0	1.0098
15.0	1.0089
20.0	1.0081
25.0	1.0072
30.0	1.0064
35.0	1.0055
40.0	1.0047
45.0	1.0038
50.0	1.0030
55.0	1.0021
60.0	1.0013
65.0	1.0004
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0137
95.0	1.0336
100.0	1.0538
105.0	1.0745
110.0	1.0956

EXHIBIT 4.07



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 8              STD ERROR(LOW TEMP)    17.71%
N(FTP TEMP) 4              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 4              STD ERROR(HIGHTEMP)     8.70%

     EFFECT(LOW TEMP) = EXP(-0.000246 (TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP( 0.008547 (TEMP-86.5))
```

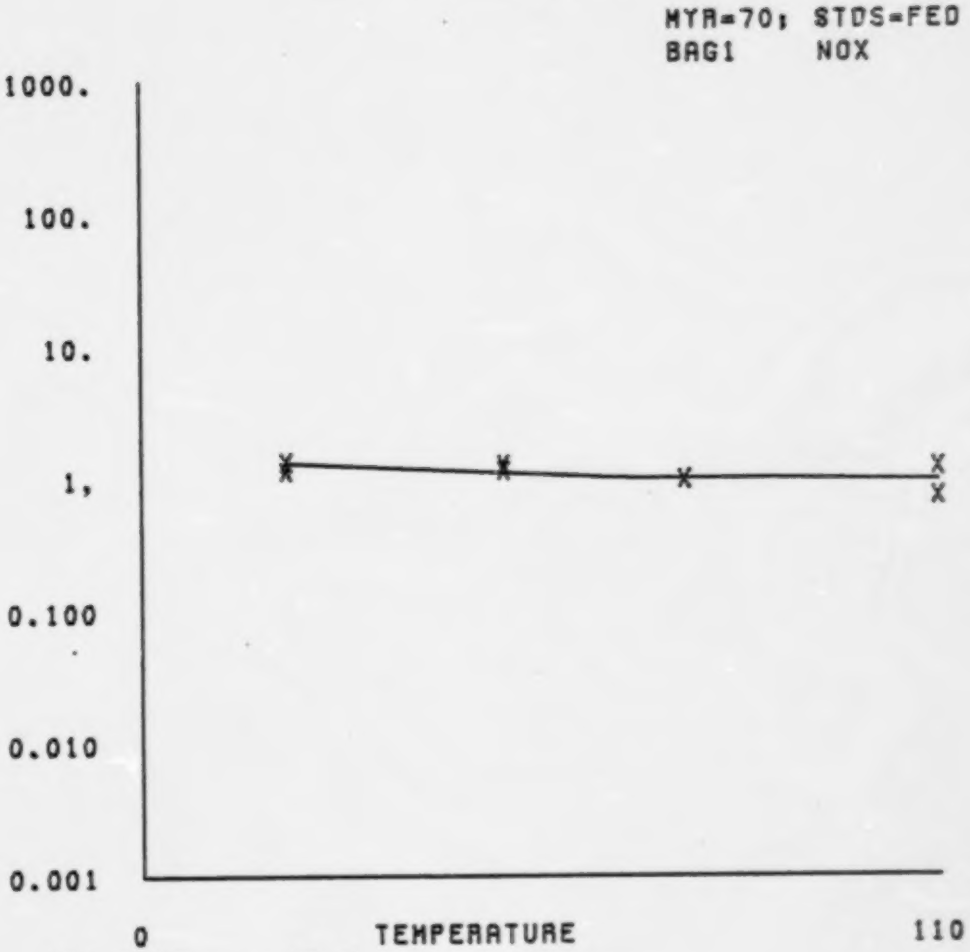
EXHIBIT 4.08

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 69FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0167
5.0	1.0155
10.0	1.0142
15.0	1.0130
20.0	1.0117
25.0	1.0105
30.0	1.0093
35.0	1.0080
40.0	1.0068
45.0	1.0055
50.0	1.0043
55.0	1.0031
60.0	1.0018
65.0	1.0006
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0304
95.0	1.0754
100.0	1.1223
105.0	1.1713
110.0	1.2225

EXHIBIT 4.09



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 4            STD ERROR(LOW TEMP)    10.52%
N(FTP TEMP) 2            STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 2            STD ERROR(HIGHTEMP)    25.36%

     EFFECT(LOW TEMP)  = EXP(-0.005702(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.002023(TEMP-86.5))
```

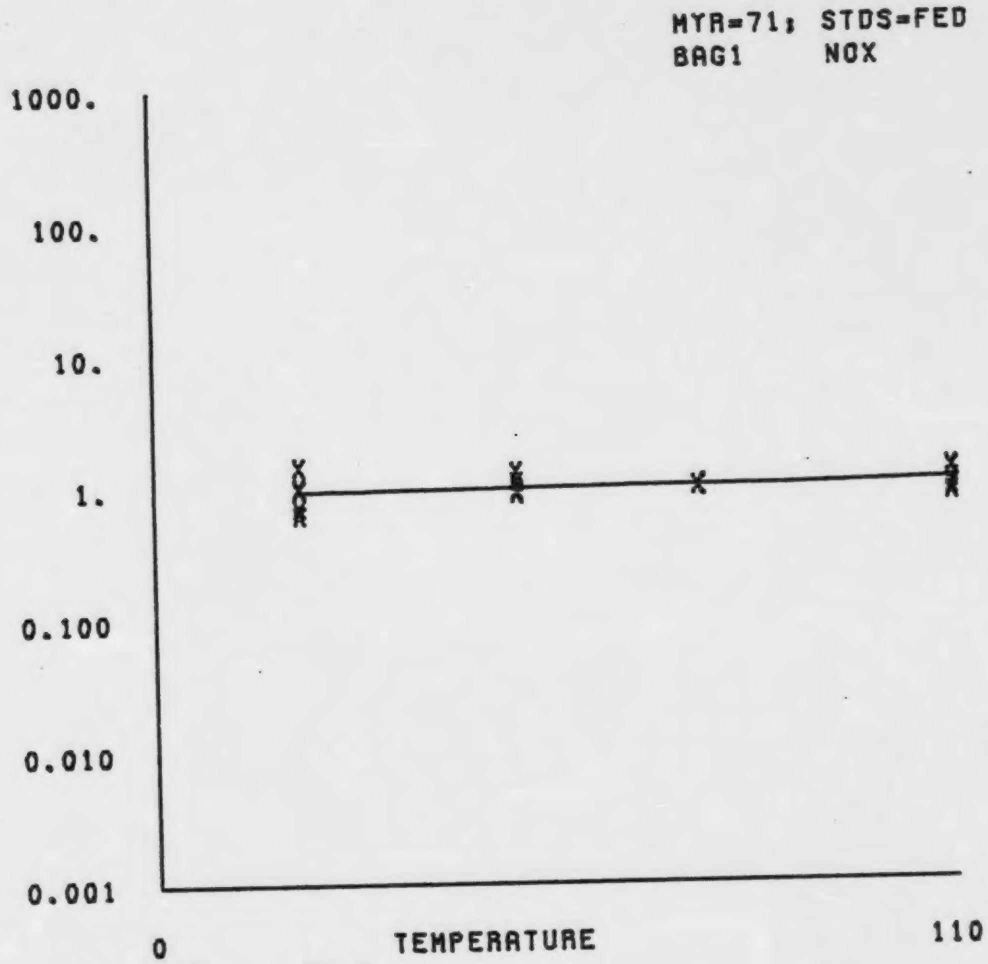
EXHIBIT 4.10

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 70FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.4695
5.0	1.4282
10.0	1.3880
15.0	1.3490
20.0	1.3111
25.0	1.2742
30.0	1.2384
35.0	1.2036
40.0	1.1698
45.0	1.1369
50.0	1.1049
55.0	1.0739
60.0	1.0437
65.0	1.0144
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9929
95.0	0.9830
100.0	0.9731
105.0	0.9633
110.0	0.9536

EXHIBIT 4.11



MIN TEMP = 20.0
MAX TEMP = 110.00

N (LOW TEMP) 10
N (FTP TEMP) 5
N (HIGHTEMP) 5

STD ERROR (LOW TEMP) 23.32%
STD ERROR (FTP TEMP) 0.0 %
STD ERROR (HIGHTEMP) 17.34%

EFFECT (LOW TEMP) = EXP(0.001358 (TEMP-67.5))
EFFECT (HIGHTEMP) = EXP(0.002598 (TEMP-86.5))

EXHIBIT 4.12

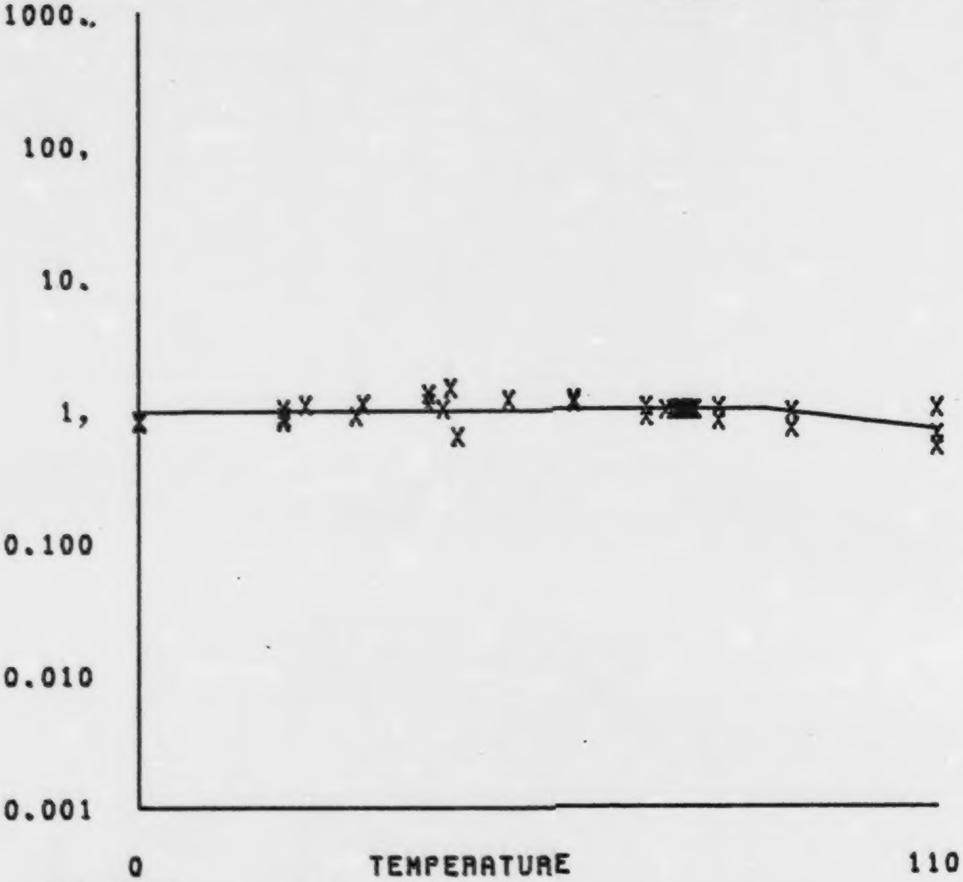
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF. NOX 71FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9124
5.0	0.9186
10.0	0.9249
15.0	0.9312
20.0	0.9375
25.0	0.9439
30.0	0.9503
35.0	0.9568
40.0	0.9633
45.0	0.9699
50.0	0.9765
55.0	0.9832
60.0	0.9899
65.0	0.9966
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0091
95.0	1.0223
100.0	1.0357
105.0	1.0492
110.0	1.0629

EXHIBIT 4.13

MYR=72; STDS=FED
BAG1 NOX



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 16          STD ERROR(LOW TEMP)    20.66%
N(FTP TEMP) 12          STD ERROR(FTP TEMP)    13.24%
N(HIGHTEMP) 5           STD ERROR(HIGHTEMP)    24.47%

     EFFECT(LOW TEMP) = EXP( 0.000455(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.015180(TEMP-86.5))
```

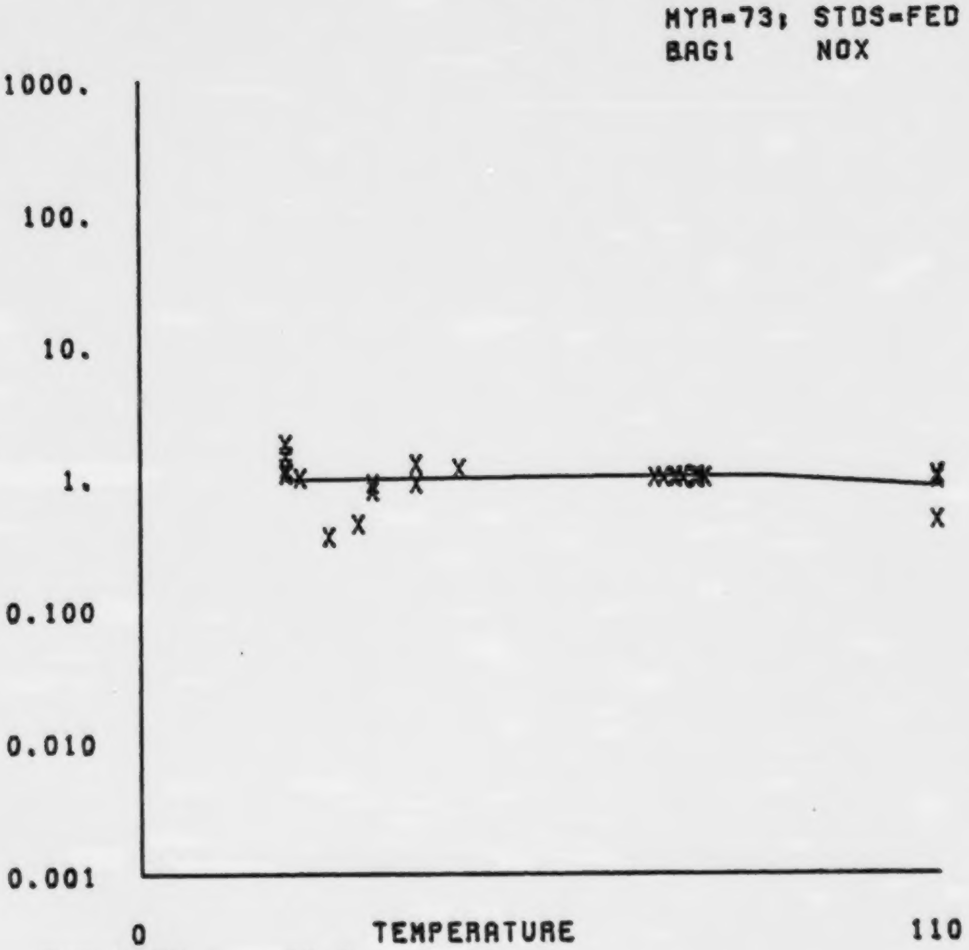
EXHIBIT 4.14

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 72FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9697
5.0	0.9719
10.0	0.9742
15.0	0.9764
20.0	0.9786
25.0	0.9808
30.0	0.9831
35.0	0.9853
40.0	0.9876
45.0	0.9898
50.0	0.9921
55.0	0.9943
60.0	0.9966
65.0	0.9989
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9483
95.0	0.8791
100.0	0.8149
105.0	0.7554
110.0	0.7003

EXHIBIT 4.15



```
MIN TEMP =    20.0
MAX TEMP = 110.00

N(LOW TEMP)  12                 STD ERROR(LOW TEMP)    44.14%
N(FTP TEMP)  12                 STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP)  4                  STD ERROR(HIGHTEMP)    32.55%

      EFFECT(LOW TEMP)  = EXP( 0.001043(TEMP-67.5))
      EFFECT(HIGHTEMP)  = EXP(-0.007923(TEMP-86.5))
```

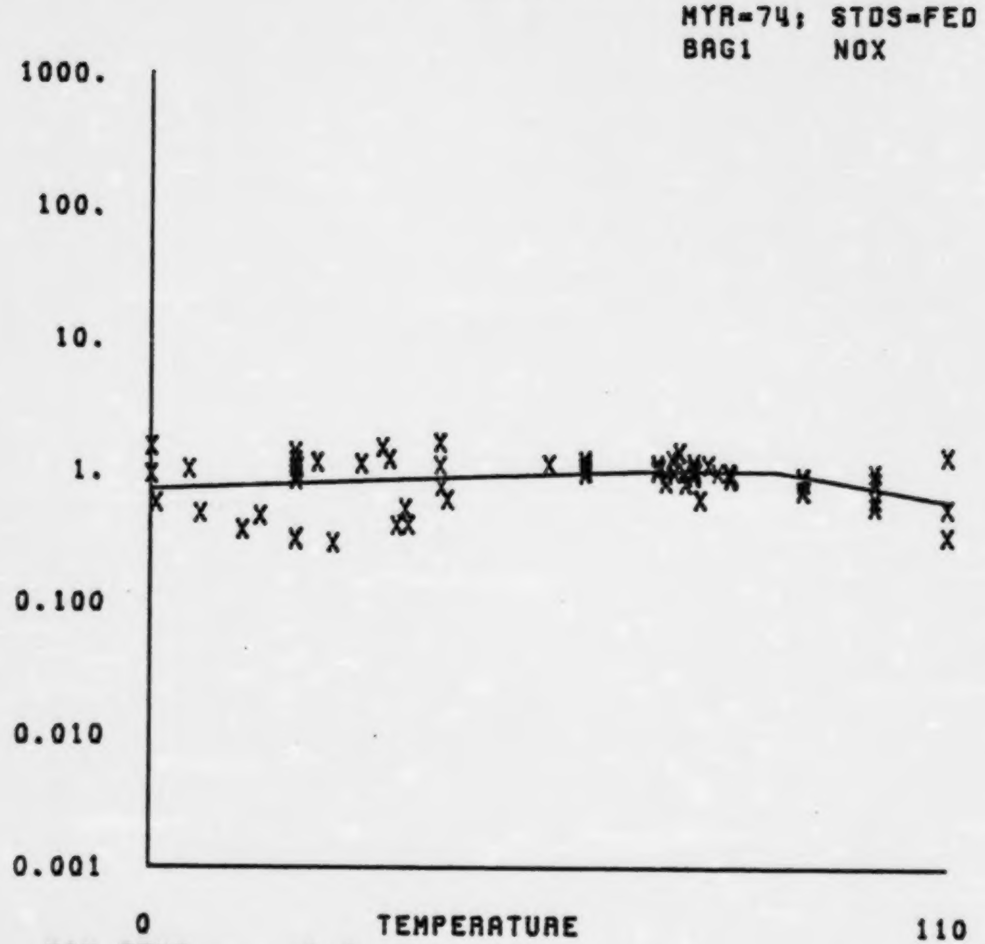
EXHIBIT 4.16

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 73FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9320
5.0	0.9369
10.0	0.9418
15.0	0.9467
20.0	0.9517
25.0	0.9566
30.0	0.9616
35.0	0.9667
40.0	0.9717
45.0	0.9768
50.0	0.9819
55.0	0.9870
60.0	0.9922
65.0	0.9974
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9727
95.0	0.9349
100.0	0.8986
105.0	0.8637
110.0	0.8301

EXHIBIT 4.17



```
MIN TEMP =   -6.9
MAX TEMP = 110.00

N(LOW TEMP) 36                  STD ERROR(LOW TEMP)    48.71%
N(FTP TEMP) 28                  STD ERROR(FTP TEMP)    19.80%
N(HIGHTEMP) 12                  STD ERROR(HIGHTEMP)    33.56%

     EFFECT(LOW TEMP) = EXP( 0.004968(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.022408(TEMP-86.5))
```

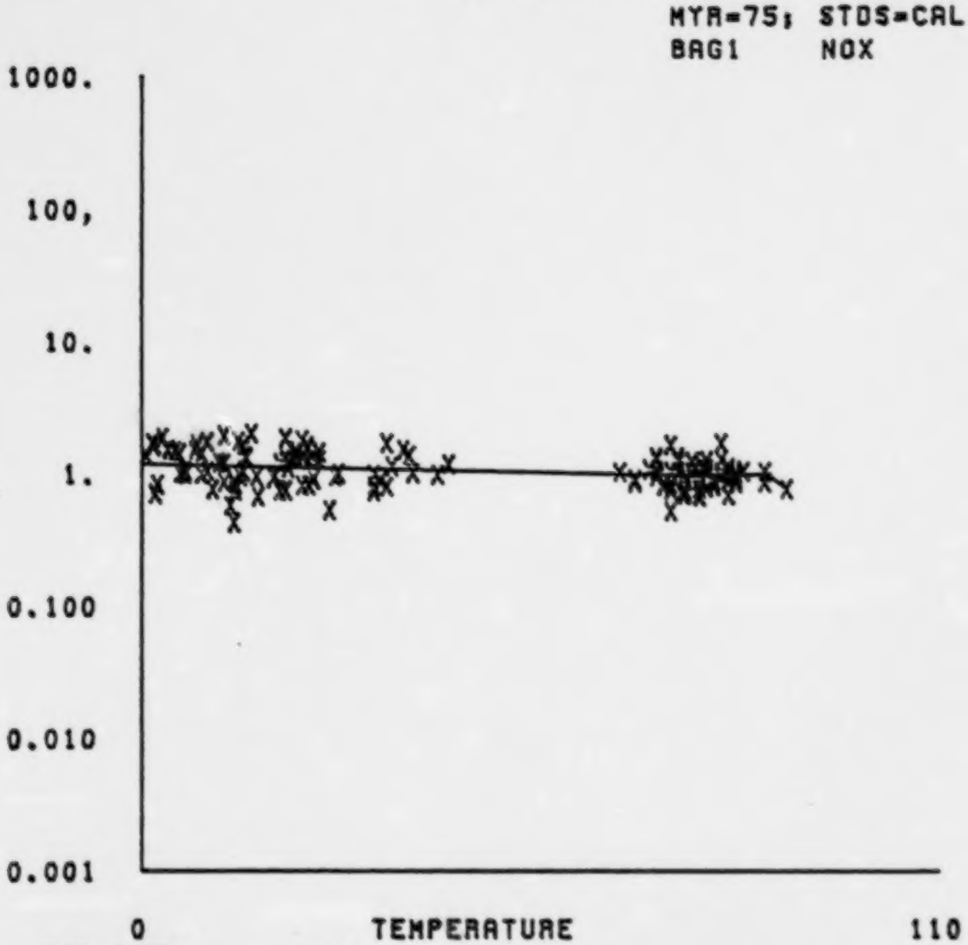
EXHIBIT 4.18

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 74FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.7151
5.0	0.7331
10.0	0.7515
15.0	0.7704
20.0	0.7898
25.0	0.8096
30.0	0.8300
35.0	0.8509
40.0	0.8723
45.0	0.8942
50.0	0.9167
55.0	0.9398
60.0	0.9634
65.0	0.9877
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9246
95.0	0.8266
100.0	0.7390
105.0	0.6606
110.0	0.5906

EXHIBIT 4.19



MIN TEMP = -7.1
MAX TEMP = 89.00

N(LOW TEMP)	91	STD ERROR(LOW TEMP)	32.92%
N(FTP TEMP)	54	STD ERROR(FTP TEMP)	22.59%
N(HIGHTEMP)	1	STD ERROR(HIGHTEMP)	0.0 %

EFFECT(LOW TEMP) = EXP(-0.002603(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(-0.099861(TEMP-86.5))

EXHIBIT 4.20

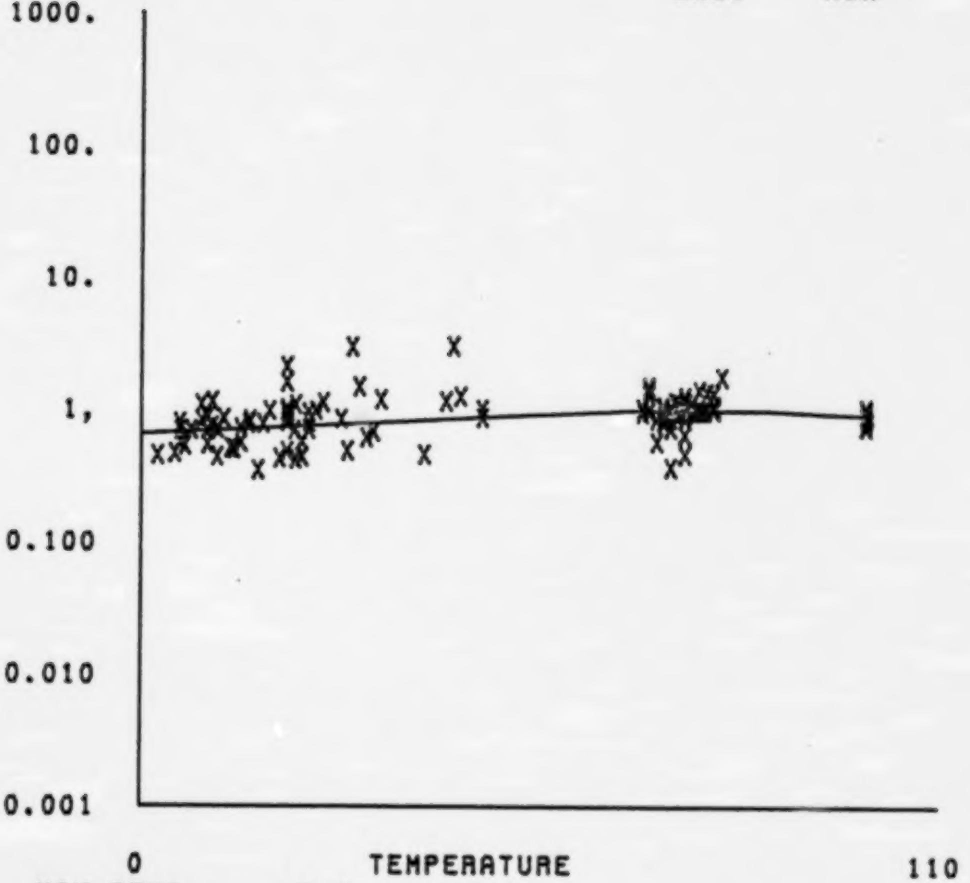
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 75CAL

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.1921
5.0	1.1767
10.0	1.1615
15.0	1.1464
20.0	1.1316
25.0	1.1170
30.0	1.1025
35.0	1.0883
40.0	1.0742
45.0	1.0603
50.0	1.0466
55.0	1.0331
60.0	1.0197
65.0	1.0065
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.7050
95.0	0.4279
100.0	0.2597
105.0	0.1576
110.0	0.0957

EXHIRIT 4.21

MYR=75; STDS=FED
BAG1 NOX



```
MIN TEMP =    -5.8
MAX TEMP = 100.00

N(LOW TEMP) 68              STD ERROR(LOW TEMP)    42.78%
N(FTP TEMP) 62              STD ERROR(FTP TEMP)    32.39%
N(HIGHTEMP) 9               STD ERROR(HIGHTEMP)    11.74%

      EFFECT(LOW TEMP) = EXP( 0.006328(TEMP-67.5))
      EFFECT(HIGHTEMP) = EXP(-0.007142(TEMP-88.5))
```

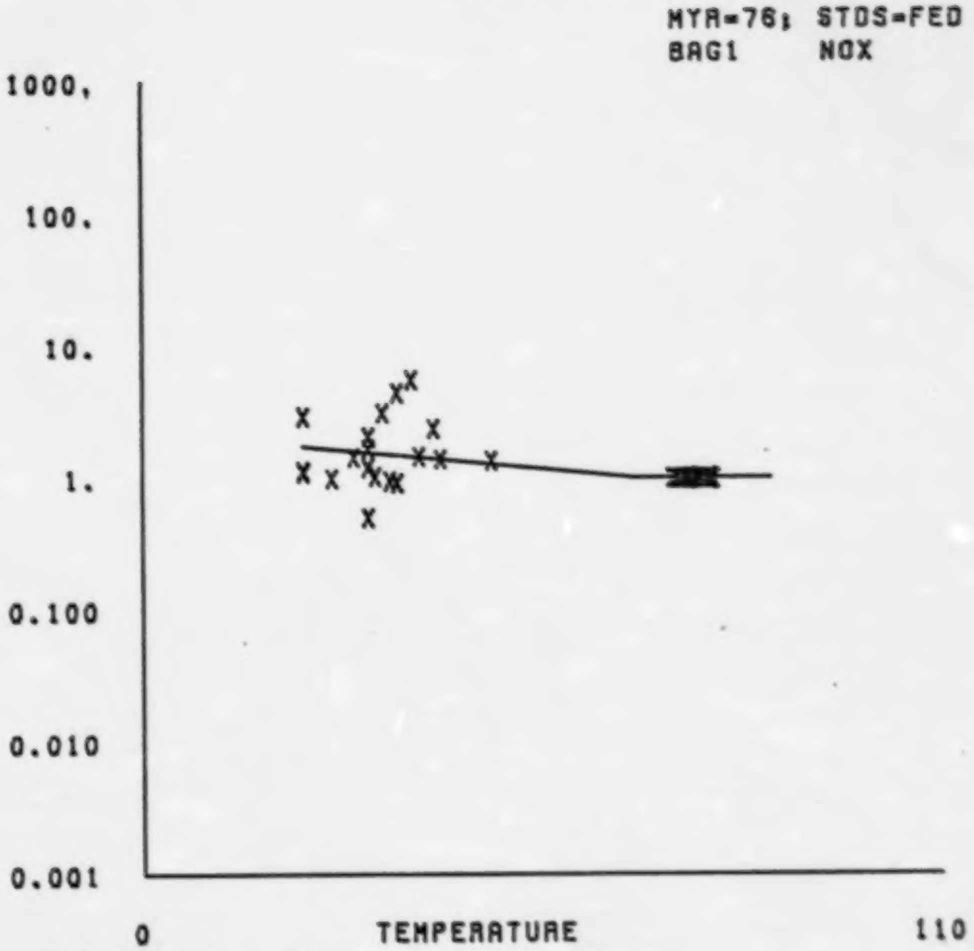
EXHIPIT 4.22

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 75FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.6524
5.0	0.6734
10.0	0.6950
15.0	0.7173
20.0	0.7404
25.0	0.7642
30.0	0.7888
35.0	0.8141
40.0	0.8403
45.0	0.8673
50.0	0.8952
55.0	0.9240
60.0	0.9537
65.0	0.9843
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9753
95.0	0.9411
100.0	0.9081
105.0	0.8762
110.0	0.8455

EXHIBIT 4.23



```
MIN TEMP =   22.0
MAX TEMP =   78.70

N(LOW TEMP) 19              STD ERROR(LOW TEMP)    59.76%
N(FTP TEMP) 19              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 0               STD ERROR(HIGHTEMP)     0.0 %

     EFFECT(LOW TEMP) = EXP(-0.012122(TEMP-67.5))
```

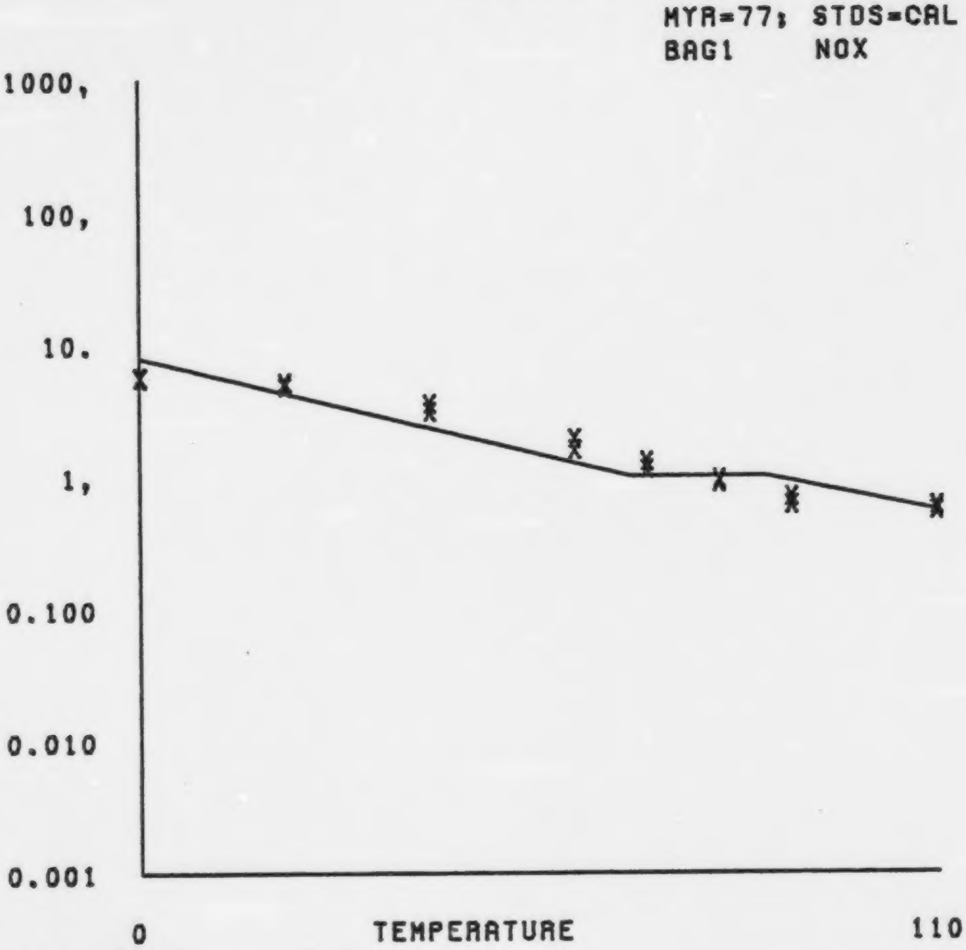
EXHIBIT 4.24

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 76FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.2665
5.0	2.1332
10.0	2.0077
15.0	1.8897
20.0	1.7785
25.0	1.6739
30.0	1.5755
35.0	1.4828
40.0	1.3956
45.0	1.3136
50.0	1.2363
55.0	1.1636
60.0	1.0952
65.0	1.0308
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	No data
95.0	" "
100.0	" "
105.0	" "
110.0	" "

EXHIBIT 4.25



MIN TEMP = 0.0
MAX TEMP = 110.00

N(LOW TEMP)	8	STD ERROR(LOW TEMP)	31.85%
N(FTP TEMP)	4	STD ERROR(FTP TEMP)	18.99%
N(HIGHTEMP)	4	STD ERROR(HIGHTEMP)	23.66%

EFFECT(LOW TEMP) = EXP(-0.030513(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(-0.025660(TEMP-86.5))

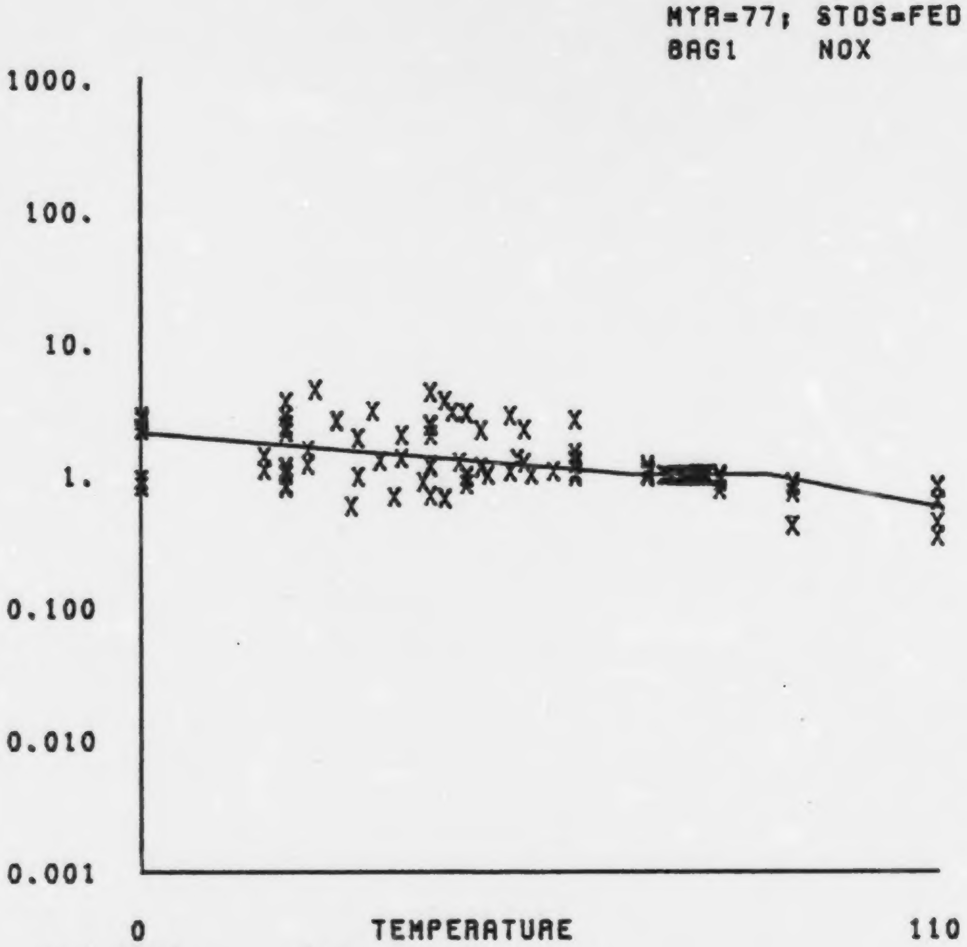
EXHIBIT 4.26

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 77CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	7.8430
5.0	6.7332
10.0	5.7805
15.0	4.9626
20.0	4.2604
25.0	3.6576
30.0	3.1400
35.0	2.6957
40.0	2.3143
45.0	1.9868
50.0	1.7057
55.0	1.4643
60.0	1.2571
65.0	1.0793
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9141
95.0	0.8040
100.0	0.7072
105.0	0.6221
110.0	0.5472

EXHIBIT 4.27



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 65              STD ERROR(LOW TEMP)    51.52%
N(FTP TEMP) 48              STD ERROR(FTP TEMP)    11.34%
N(HIGHTEMP) 12              STD ERROR(HIGHTEMP)    40.36%

     EFFECT(LOW TEMP) = EXP(-0.010851(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.024563(TEMP-86.5))
```

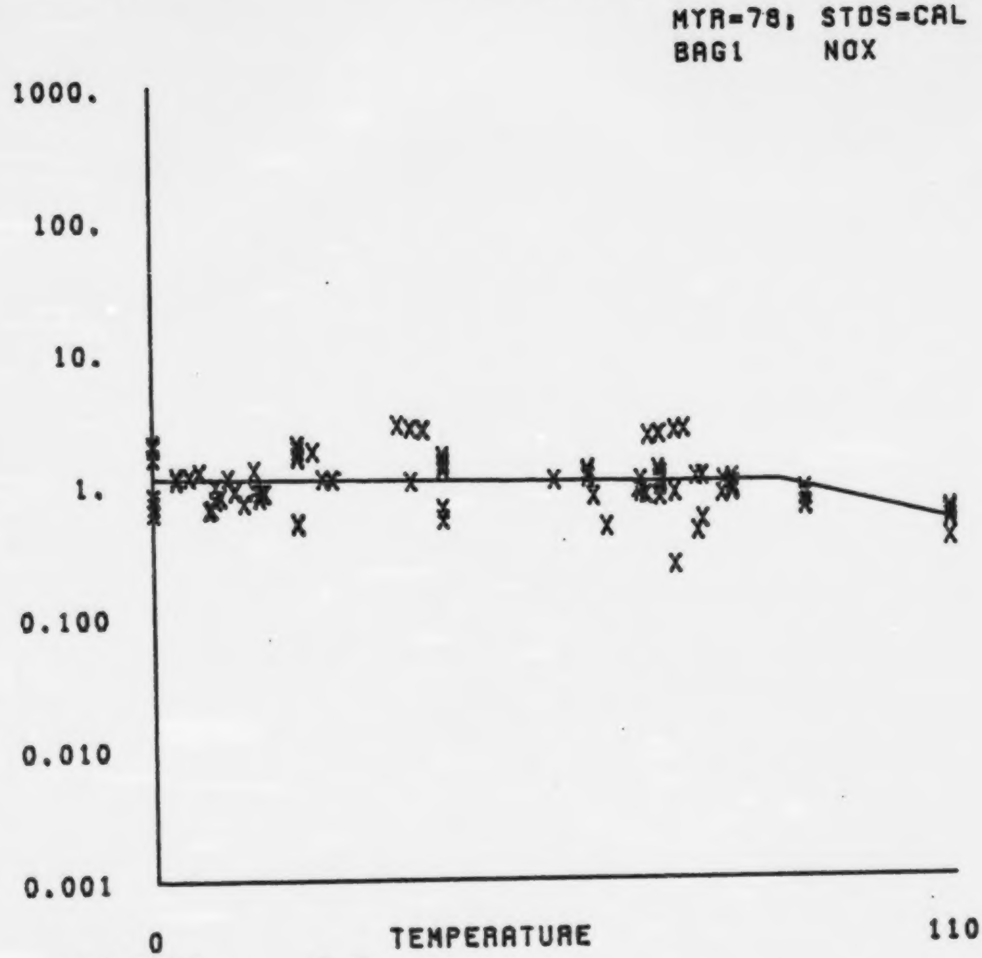
EXHIBIT 4.28

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 77FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	2.0802
5.0	1.9703
10.0	1.8663
15.0	1.7677
20.0	1.6744
25.0	1.5859
30.0	1.5022
35.0	1.4229
40.0	1.3477
45.0	1.2765
50.0	1.2091
55.0	1.1453
60.0	1.0848
65.0	1.0275
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9176
95.0	0.8116
100.0	0.7178
105.0	0.6348
110.0	0.5615

EXHIBIT 4.29



```
MIN TEMP =    -3.8
MAX TEMP = 110.00

N(LOW TEMP) 57                    STD ERROR(LOW TEMP)    42.38%
N(FTP TEMP) 29                    STD ERROR(FTP TEMP)    52.63%
N(HIGHTEMP) 12                    STD ERROR(HIGHTEMP)    20.36%

      EFFECT(LOW TEMP)  = EXP(-0.001326 (TEMP-67.5))
      EFFECT(HIGHTEMP)  = EXP(-0.030347 (TEMP-86.5))
```

EXHIBIT 4.30

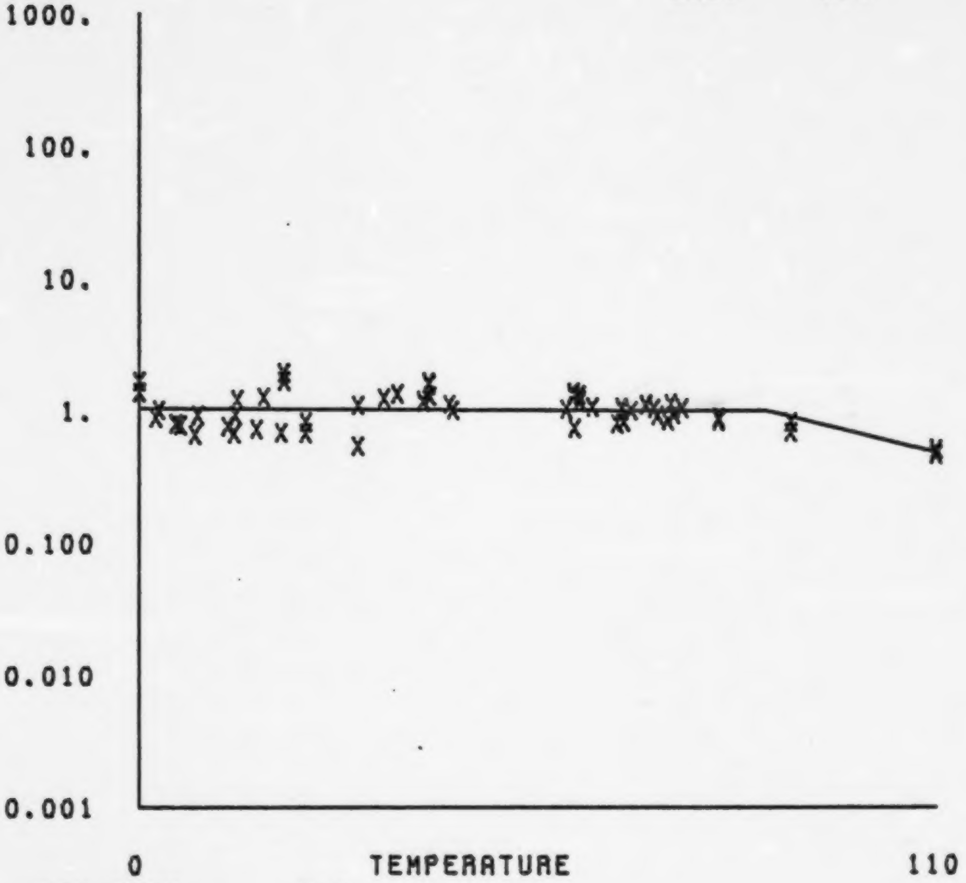
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX   78CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0936
5.0	1.0864
10.0	1.0792
15.0	1.0721
20.0	1.0650
25.0	1.0580
30.0	1.0510
35.0	1.0440
40.0	1.0371
45.0	1.0303
50.0	1.0235
55.0	1.0167
60.0	1.0100
65.0	1.0033
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.8992
95.0	0.7726
100.0	0.6639
105.0	0.5704
110.0	0.4901

EXHIBIT 4.31

MYR=78; STDS=FED
BAG1 NOX



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 42              STD ERROR(LOW TEMP)    30.16%
N(FTP TEMP) 11              STD ERROR(FTP TEMP)    13.47%
N(HIGHTEMP) 4               STD ERROR(HIGHTEMP)    13.87%

    EFFECT(LOW TEMP)  = EXP(-0.000526(TEMP-67.5))
    EFFECT(HIGHTEMP)  = EXP(-0.031317(TEMP-88.5))
```

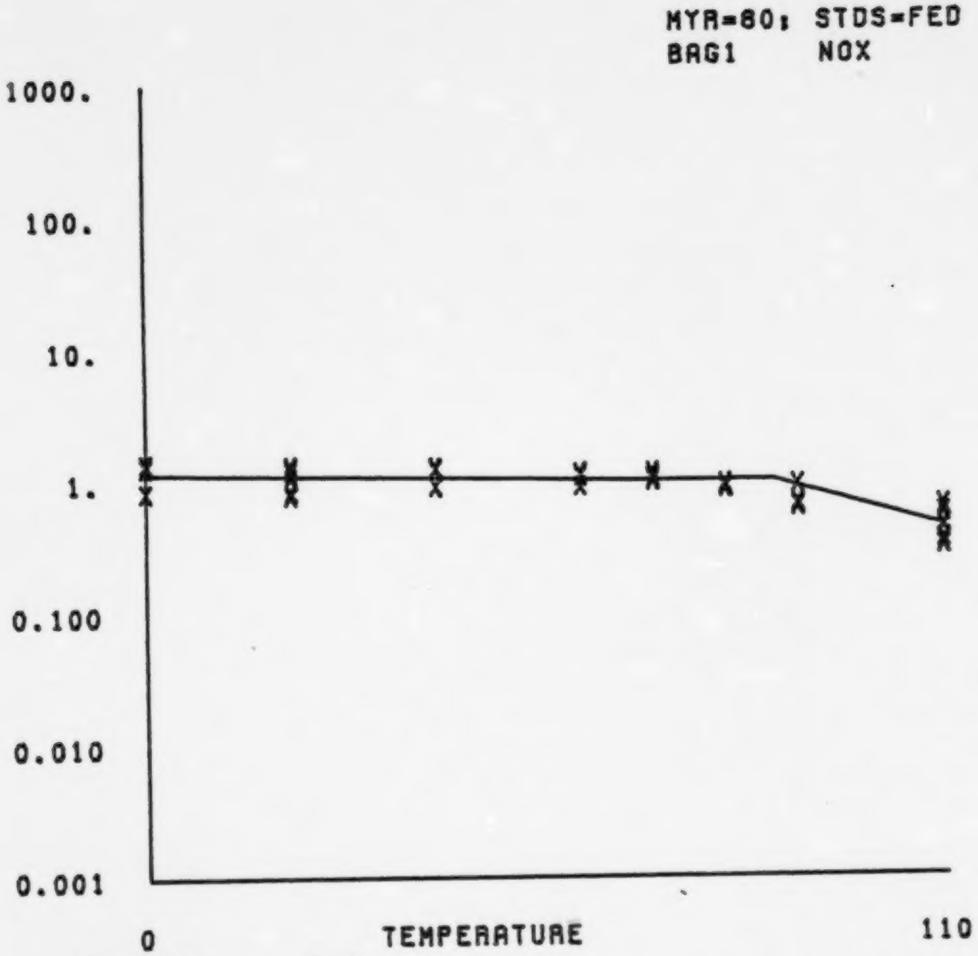
EXHIBIT 4.32

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX 78FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.0361
5.0	1.0334
10.0	1.0307
15.0	1.0280
20.0	1.0253
25.0	1.0226
30.0	1.0199
35.0	1.0172
40.0	1.0146
45.0	1.0119
50.0	1.0092
55.0	1.0066
60.0	1.0040
65.0	1.0013
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.8962
95.0	0.7663
100.0	0.6552
105.0	0.5603
110.0	0.4790

EXHIBIT 4.33



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 17            STD ERROR(LOW TEMP)      17.79%
N(FTP TEMP) 11            STD ERROR(FTP TEMP)      11.28%
N(HIGHTEMP) 10            STD ERROR(HIGHTEMP)      25.31%

     EFFECT(LOW TEMP)  = EXP(-0.002113(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.035507(TEMP-86.5))
```

EXHIBIT 4.34

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG1 OF NOX   80FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.1533
5.0	1.1412
10.0	1.1292
15.0	1.1173
20.0	1.1056
25.0	1.0940
30.0	1.0825
35.0	1.0711
40.0	1.0598
45.0	1.0487
50.0	1.0377
55.0	1.0268
60.0	1.0160
65.0	1.0053
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.8831
95.0	0.7395
100.0	0.6192
105.0	0.5185
110.0	0.4341

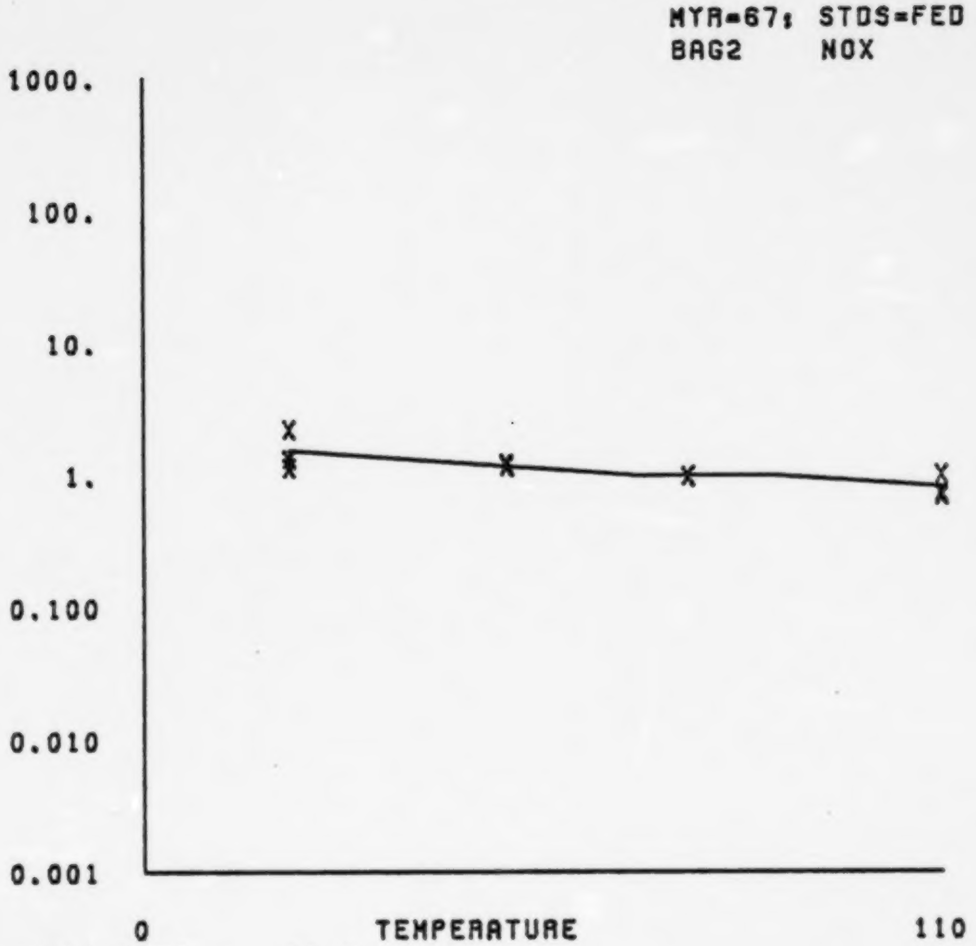
EXHIBIT 4.35: FITTED TEMPERATURE EFFECTS, NO_x BAG2

$$\frac{\text{EMISSIONS AT TEMPERATURE T}}{\text{EMISSIONS AT FTP TEMPERATURE}} = \begin{cases} \exp[c(T-67.5)] & \text{for T less than 67.5} \\ \exp[d(T-86.5)] & \text{for T greater than 86.5} \end{cases}$$

where exp is the exponential function and c and d are as tabled below.

MYR STDS	c	d
67FED	-.00892447	-.00873250
69FED	-.00607663	.00160651
70FED	-.00594412	-.00553861
71FED	-.00488443	-.00483421
72FED	-.00658573	-.02951612
73FED	-.00833861	-.00813647
74FED	.00023027	-.01189702
75CAL	.00050947	-.12033230
75FED	.00141492	-.00879145
76FED	-.00814905	NO DATA
77CAL	-.00503345	-.02050744
77FED	-.00751858	-.01553520
78CAL	-.00226384	-.02235498
78FED	-.00562601	-.02941683
80FED	-.00303196	-.04162257

EXHIBIT 4.36



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 6                 STD ERROR(LOW TEMP)    20.39%
N(FTP TEMP) 3                 STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 3                 STD ERROR(HIGHTEMP)    16.54%

     EFFECT(LOW TEMP) = EXP(-0.008924 (TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.008733 (TEMP-86.5))
```

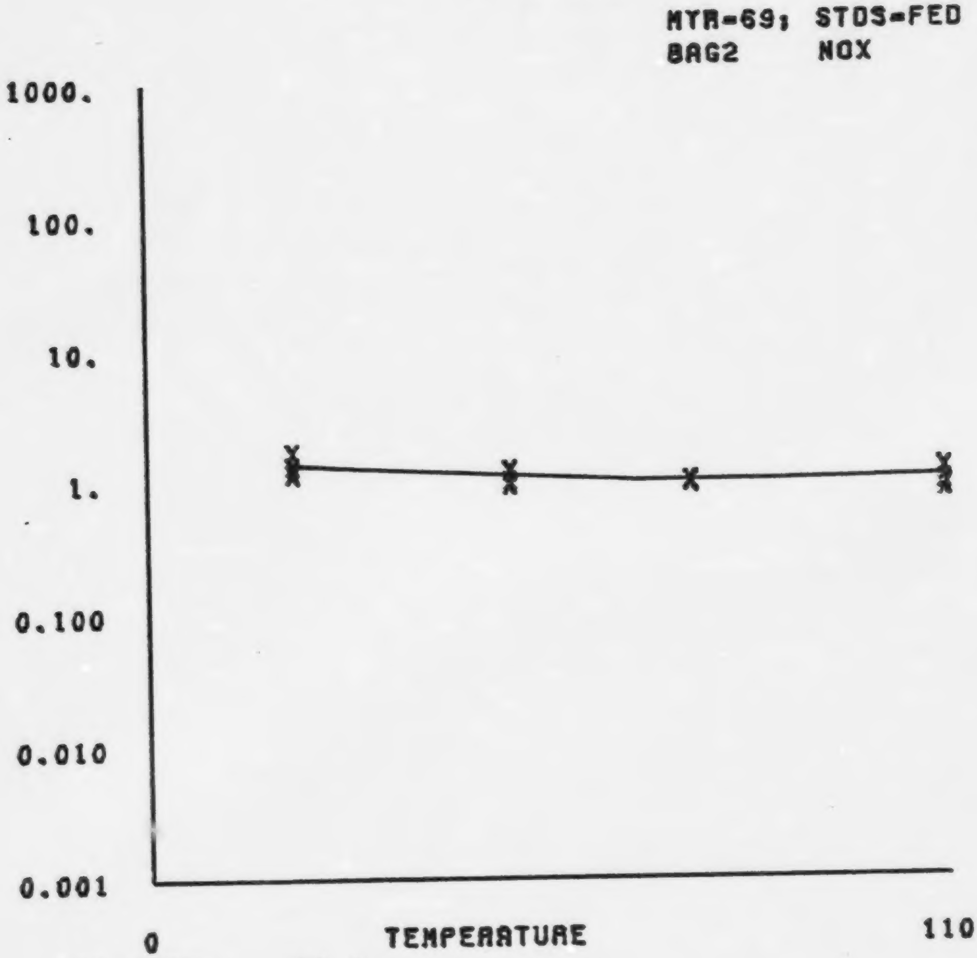
EXHIBIT 4.37

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 67FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.8265
5.0	1.7468
10.0	1.6706
15.0	1.5977
20.0	1.5279
25.0	1.4612
30.0	1.3975
35.0	1.3365
40.0	1.2782
45.0	1.2224
50.0	1.1690
55.0	1.1180
60.0	1.0692
65.0	1.0226
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9699
95.0	0.9285
100.0	0.8888
105.0	0.8508
110.0	0.8145

EXHIBIT 4.38



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 8              STD ERROR(LOW TEMP)    13.16%
N(FTP TEMP) 4              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 4              STD ERROR(HIGHTEMP)    15.31%

     EFFECT(LOW TEMP) = EXP(-0.006077(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP( 0.001607(TEMP-86.5))
```

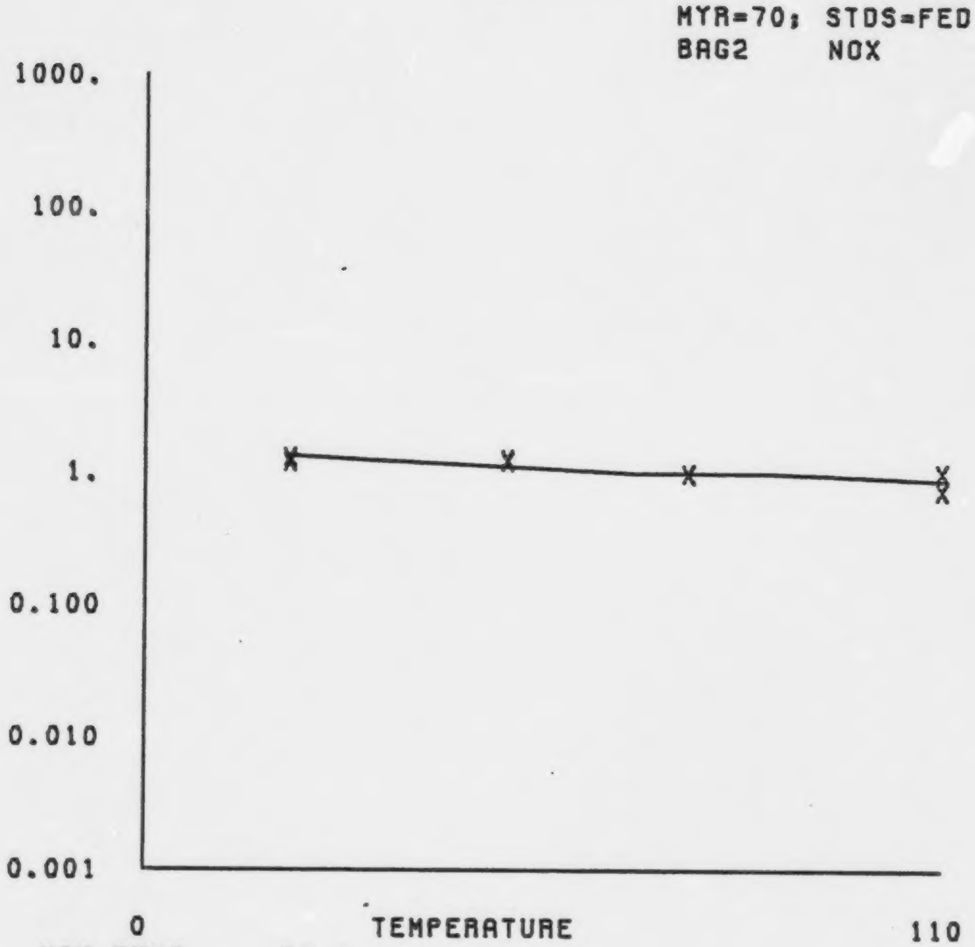
EXHIBIT 4.39

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX   69FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.5071
5.0	1.4620
10.0	1.4182
15.0	1.3758
20.0	1.3346
25.0	1.2947
30.0	1.2559
35.0	1.2183
40.0	1.1819
45.0	1.1465
50.0	1.1122
55.0	1.0789
60.0	1.0466
65.0	1.0153
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	1.0056
95.0	1.0137
100.0	1.0219
105.0	1.0302
110.0	1.0385

EXHIBIT 4.40



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 4            STD ERROR(LOW TEMP)     9.73%
N(FTP TEMP) 2            STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 2            STD ERROR(HIGHTEMP)    15.89%

     EFFECT(LOW TEMP)  = EXP(-0.005944(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.005539(TEMP-86.5))
```

EXHIBIT 4.41

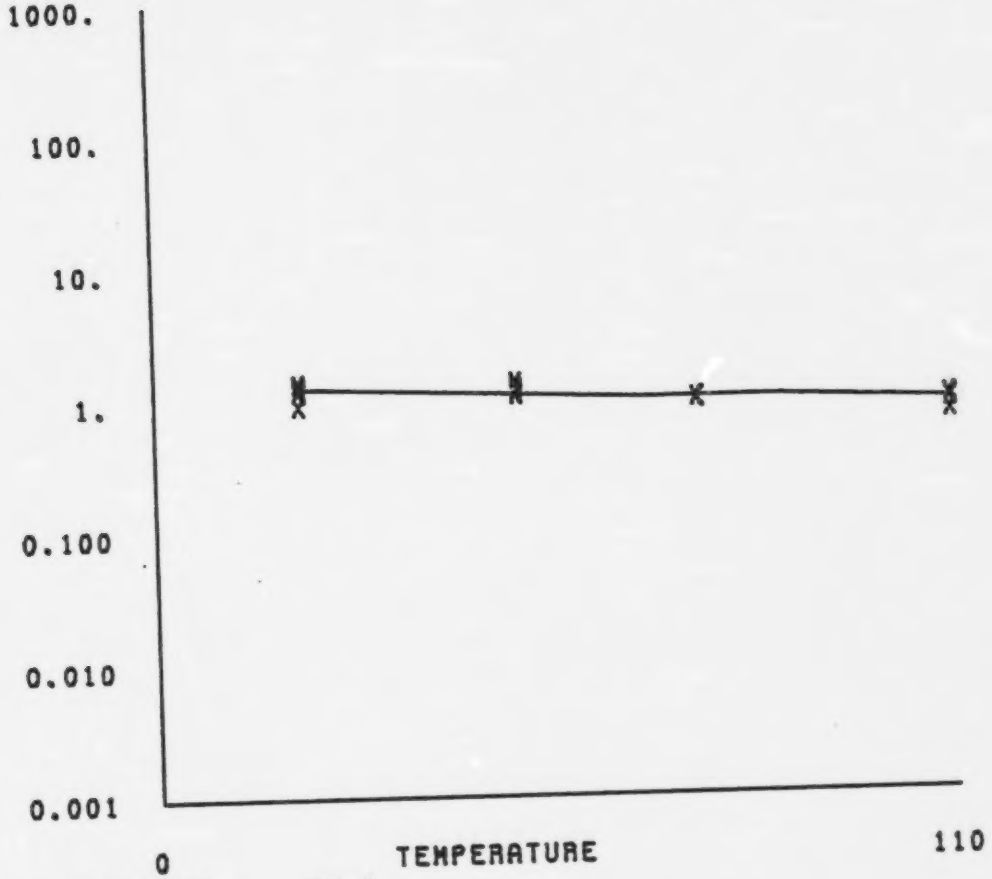
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX   70FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.4937
5.0	1.4499
10.0	1.4075
15.0	1.3662
20.0	1.3262
25.0	1.2874
30.0	1.2497
35.0	1.2131
40.0	1.1776
45.0	1.1431
50.0	1.1096
55.0	1.0771
60.0	1.0456
65.0	1.0150
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9808
95.0	0.9540
100.0	0.9280
105.0	0.9026
110.0	0.8780

EXHIBIT 4.42

MYR=71; STDS=FED
BAG2 NOX



MIN TEMP = 20.0
MAX TEMP = 110.00

N(LOW TEMP)	10	STD ERROR(LOW TEMP)	13.27%
N(FTP TEMP)	5	STD ERROR(FTP TEMP)	0.0 %
N(HIGHTEMP)	5	STD ERROR(HIGHTEMP)	9.82%

EFFECT(LOW TEMP) = EXP(-0.004884 (TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(-0.004834 (TEMP-86.5))

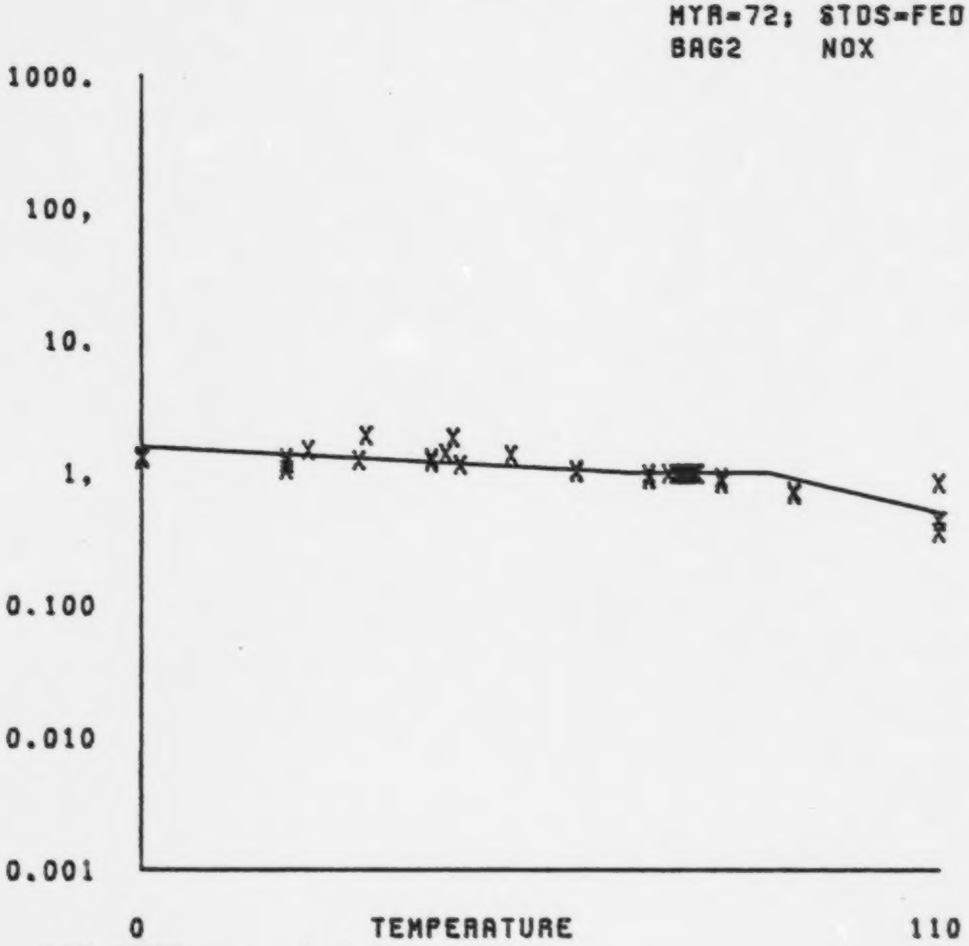
EXHIBIT 4.43

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 71FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.3905
5.0	1.3570
10.0	1.3243
15.0	1.2923
20.0	1.2611
25.0	1.2307
30.0	1.2010
35.0	1.1720
40.0	1.1438
45.0	1.1162
50.0	1.0892
55.0	1.0630
60.0	1.0373
65.0	1.0123
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9832
95.0	0.9597
100.0	0.9368
105.0	0.9144
110.0	0.8926

EXHIBIT 4.44



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 16                STD ERROR(LOW TEMP)    20.05%
N(FTP TEMP) 12                STD ERROR(FTP TEMP)    11.63%
N(HIGHTEMP) 5                 STD ERROR(HIGHTEMP)    32.18%

     EFFECT(LOW TEMP)  = EXP(-0.006586(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.029518(TEMP-86.5))
```

EXHIBIT 4.45

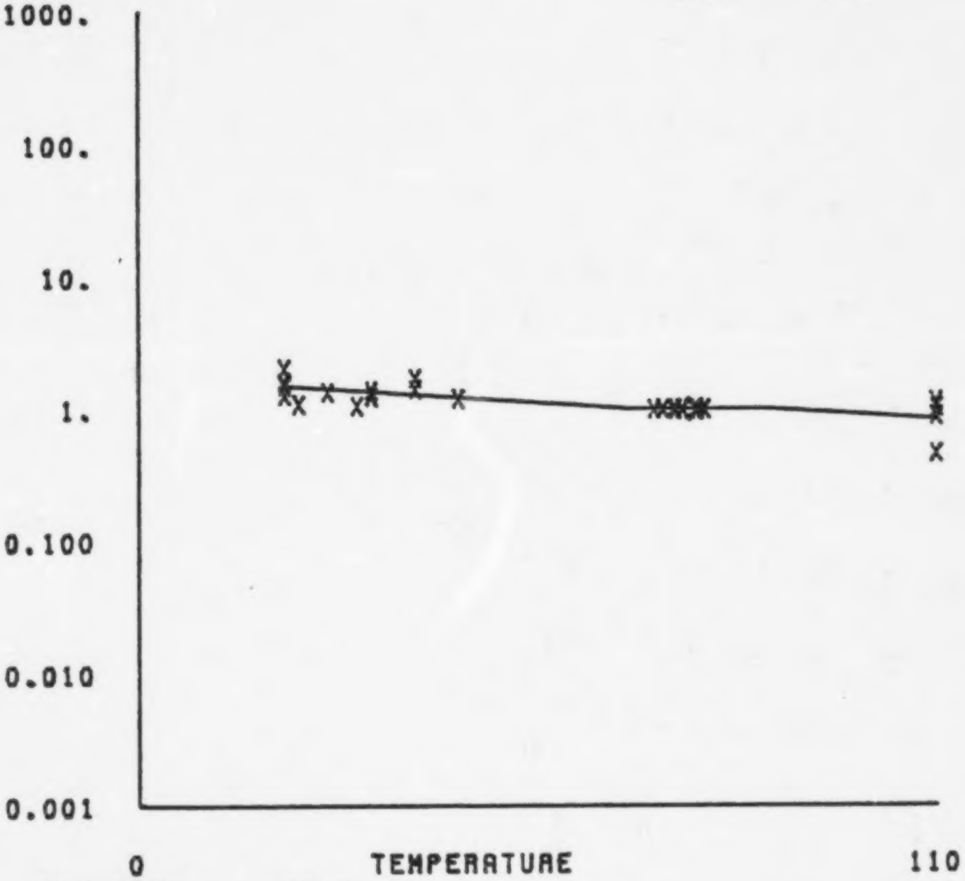
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 72FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.5598
5.0	1.5092
10.0	1.4604
15.0	1.4131
20.0	1.3673
25.0	1.3230
30.0	1.2801
35.0	1.2387
40.0	1.1985
45.0	1.1597
50.0	1.1222
55.0	1.0858
60.0	1.0506
65.0	1.0166
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9019
95.0	0.7781
100.0	0.6713
105.0	0.5792
110.0	0.4998

EXHIBIT 4.46

MYR=73; STDS=FED
BAG2 NOX



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 12               STD ERROR(LOW TEMP)    17.90%
N(FTP TEMP) 12               STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 4                STD ERROR(HIGHTEMP)    34.96%

     EFFECT(LOW TEMP)  = EXP(-0.008339 (TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.008136 (TEMP-86.5))
```

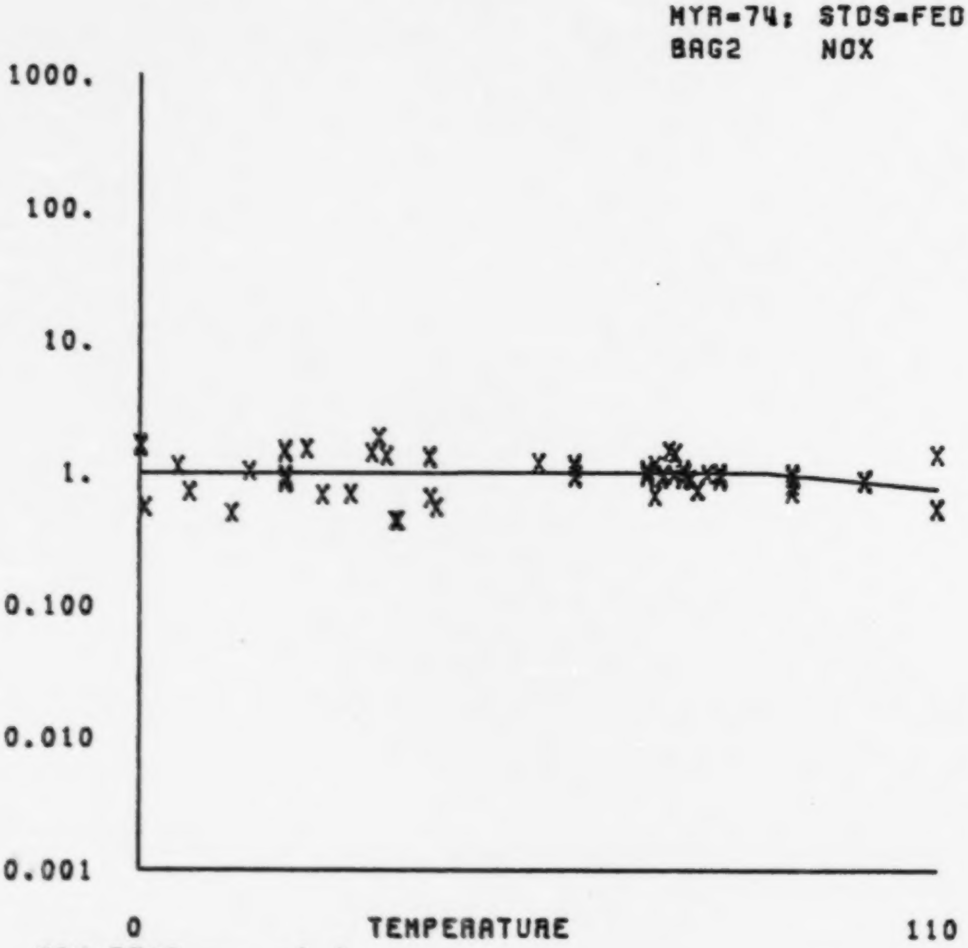
EXHIBIT 4.47

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX   73FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.7557
5.0	1.6840
10.0	1.6152
15.0	1.5493
20.0	1.4860
25.0	1.4253
30.0	1.3671
35.0	1.3113
40.0	1.2577
45.0	1.2064
50.0	1.1571
55.0	1.1099
60.0	1.0645
65.0	1.0211
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9719
95.0	0.9332
100.0	0.8960
105.0	0.8603
110.0	0.8260

EXHIBIT 4.48



```
MIN TEMP =   -6.9
MAX TEMP = 110.00

N(LOW TEMP) 36              STD ERROR(LOW TEMP)    37.61%
N(FTP TEMP) 28              STD ERROR(FTP TEMP)    20.13%
N(HIGHTEMP) 12              STD ERROR(HIGHTEMP)    24.03%

     EFFECT(LOW TEMP) = EXP( 0.000230(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.011897(TEMP-86.5))
```

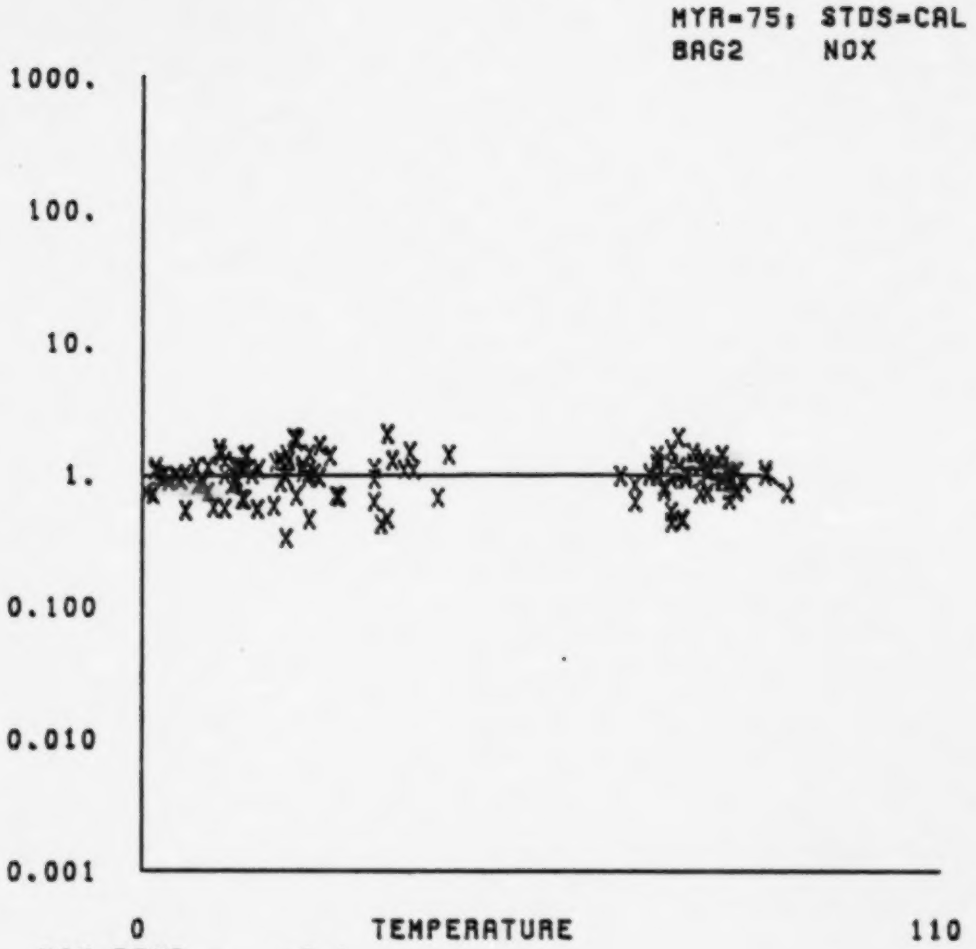
EXHIBIT 4.49

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 74FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9846
5.0	0.9857
10.0	0.9868
15.0	0.9880
20.0	0.9891
25.0	0.9903
30.0	0.9914
35.0	0.9925
40.0	0.9937
45.0	0.9948
50.0	0.9960
55.0	0.9971
60.0	0.9983
65.0	0.9994
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9592
95.0	0.9038
100.0	0.8516
105.0	0.8024
110.0	0.7561

EXHIBIT 4.50



```
MIN TEMP =   -7.1
MAX TEMP =  89.00

N(LOW TEMP) 91              STD ERROR(LOW TEMP)    34.45%
N(FTP TEMP) 54              STD ERROR(FTP TEMP)    28.66%
N(HIGHTEMP) 1               STD ERROR(HIGHTEMP)     0.0 %

     EFFECT(LOW TEMP)  = EXP( 0.000509(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.120332(TEMP-86.5))
```

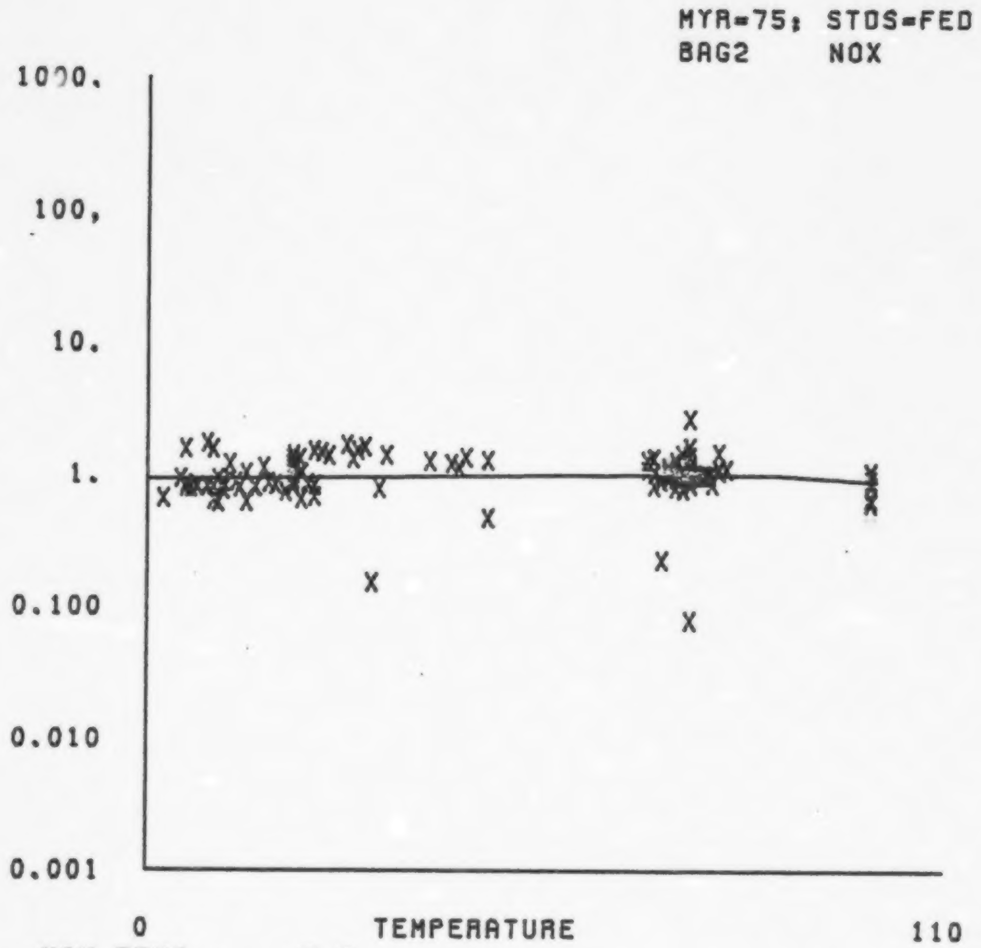
EXHIBIT 4.51

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 75CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9662
5.0	0.9687
10.0	0.9711
15.0	0.9736
20.0	0.9761
25.0	0.9786
30.0	0.9811
35.0	0.9836
40.0	0.9861
45.0	0.9886
50.0	0.9911
55.0	0.9937
60.0	0.9962
65.0	0.9987
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.6563
95.0	0.3596
100.0	0.1970
105.0	0.1079
110.0	0.0591

EXHIBIT 4.52



```
MIN TEMP =    -5.8
MAX TEMP = 100.00

N(LOW TEMP) 68                 STD ERROR(LOW TEMP)    38.05%
N(FTP TEMP) 61                 STD ERROR(FTP TEMP)    57.59%
N(HIGHTEMP) 9                  STD ERROR(HIGHTEMP)    19.42%

     EFFECT(LOW TEMP)  = EXP( 0.001415(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.008791(TEMP-86.5))
```

EXHIBIT 4.53

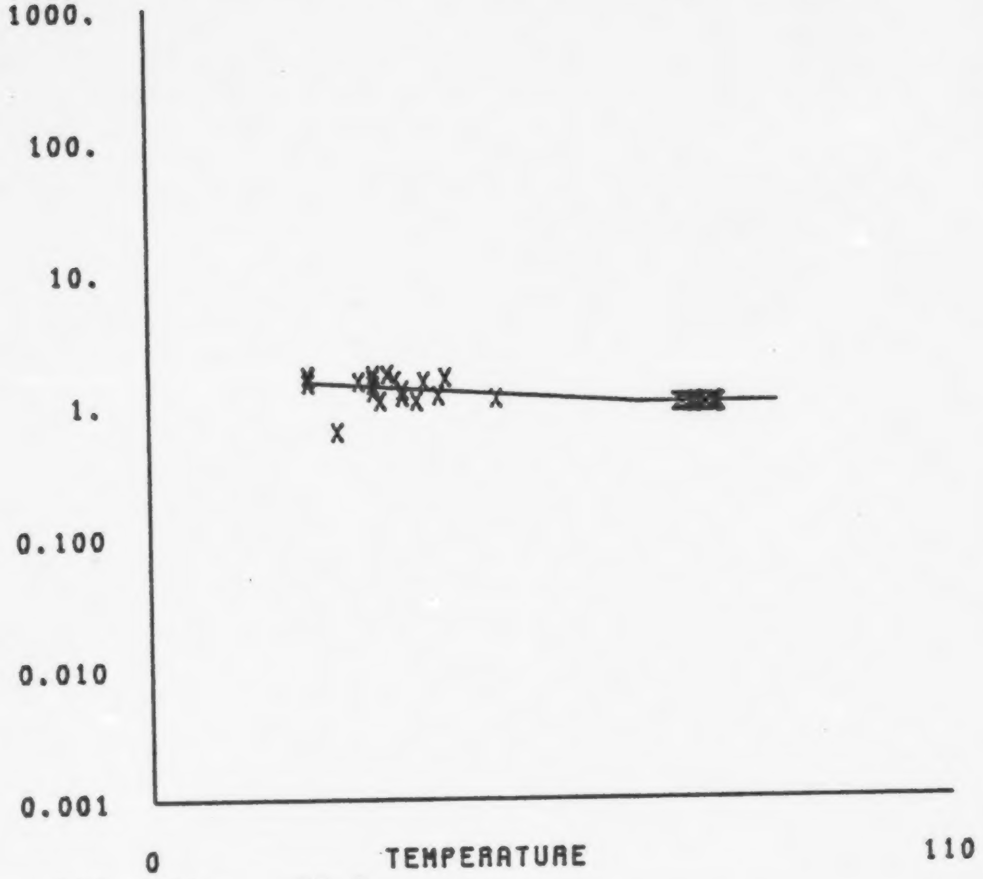
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 75FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9089
5.0	0.9154
10.0	0.9219
15.0	0.9284
20.0	0.9350
25.0	0.9416
30.0	0.9483
35.0	0.9551
40.0	0.9618
45.0	0.9687
50.0	0.9755
55.0	0.9825
60.0	0.9894
65.0	0.9965
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9697
95.0	0.9280
100.0	0.8881
105.0	0.8499
110.0	0.8133

EXHIBIT 4.54

MYR=76; STDS=FED
BAG2 NOX



MIN TEMP = 22.0
MAX TEMP = 78.70

N(LOW TEMP)	19	STD ERROR(LOW TEMP)	23.68%
N(FTP TEMP)	19	STD ERROR(FTP TEMP)	0.0 %
N(HIGHTEMP)	0	STD ERROR(HIGHTEMP)	0.0 %

EFFECT(LOW TEMP) = EXP(-0.008149(TEMP-67.5))

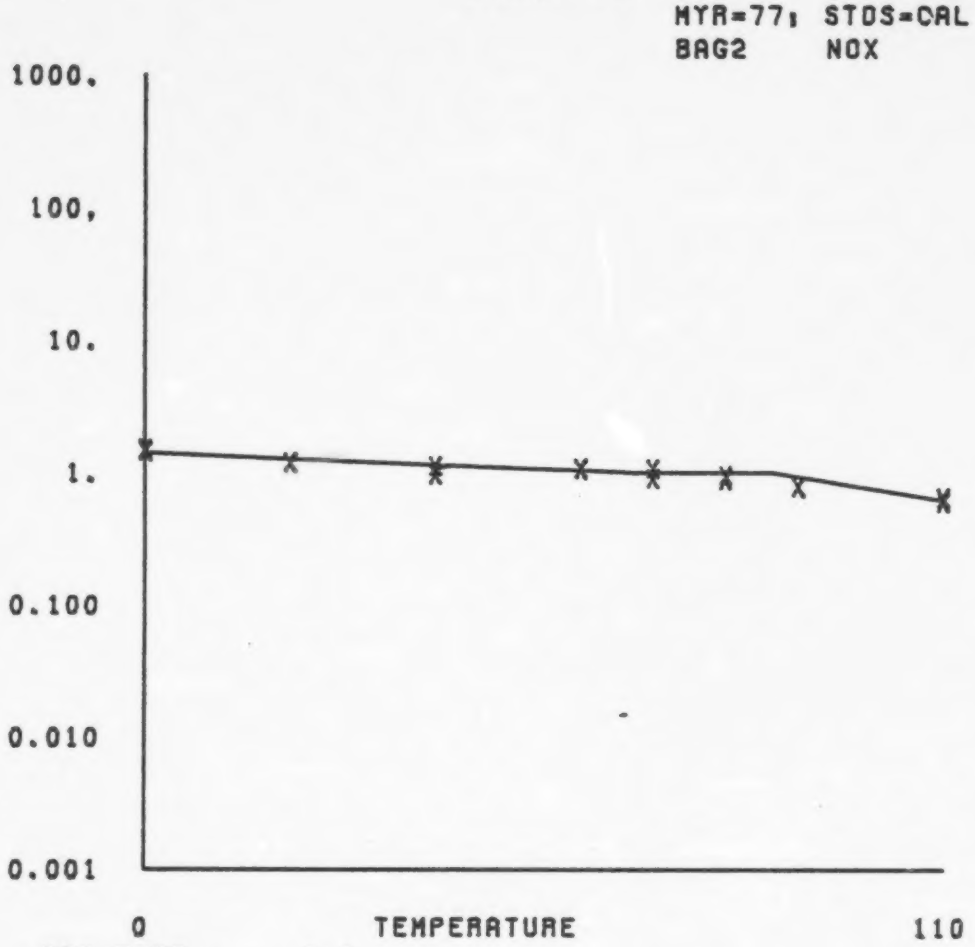
EXHIBIT 4.55

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 76FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.7334
5.0	1.6642
10.0	1.5977
15.0	1.5339
20.0	1.4727
25.0	1.4139
30.0	1.3574
35.0	1.3032
40.0	1.2512
45.0	1.2012
50.0	1.1533
55.0	1.1072
60.0	1.0630
65.0	1.0206
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	No data
95.0	" "
100.0	" "
105.0	" "
110.0	" "

EXHIBIT 4.56



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 8                STD ERROR(LOW TEMP)     7.13%
N(FTP TEMP) 4                STD ERROR(FTP TEMP)     9.48%
N(HIGHTEMP) 4                STD ERROR(HIGHTEMP)    11.84%

     EFFECT(LOW TEMP) = EXP(-0.005033(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.020507(TEMP-86.5))
```

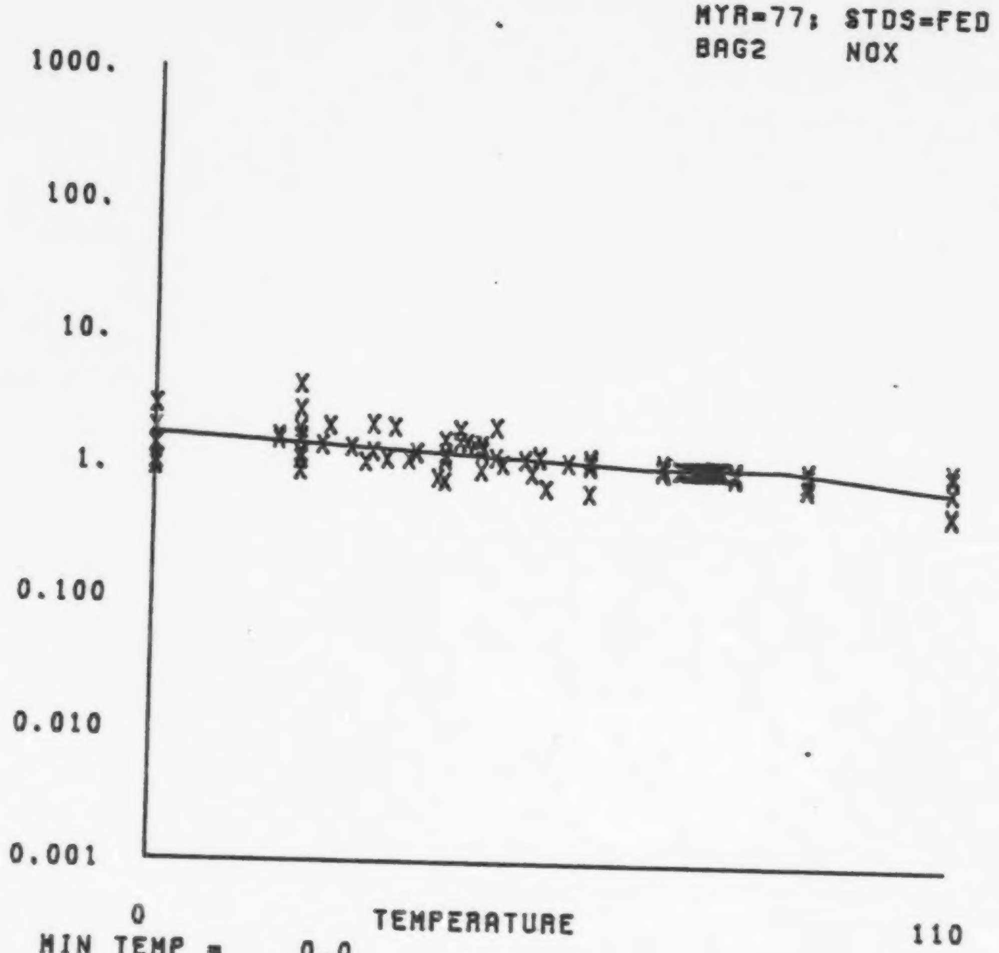
EXHIBIT 4.57

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 77CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.4046
5.0	1.3697
10.0	1.3357
15.0	1.3025
20.0	1.2701
25.0	1.2385
30.0	1.2077
35.0	1.1777
40.0	1.1485
45.0	1.1199
50.0	1.0921
55.0	1.0649
60.0	1.0385
65.0	1.0127
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9307
95.0	0.8400
100.0	0.7582
105.0	0.6843
110.0	0.6176

EXHIBIT 4.58



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 85                 STD ERROR(LOW TEMP)    28.92%
N(FTP TEMP) 48                 STD ERROR(FTP TEMP)     7.14%
N(HIGHTEMP) 12                 STD ERROR(HIGHTEMP)    22.79%

     EFFECT(LOW TEMP) = EXP(-0.007519(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.015535(TEMP-86.5))
```

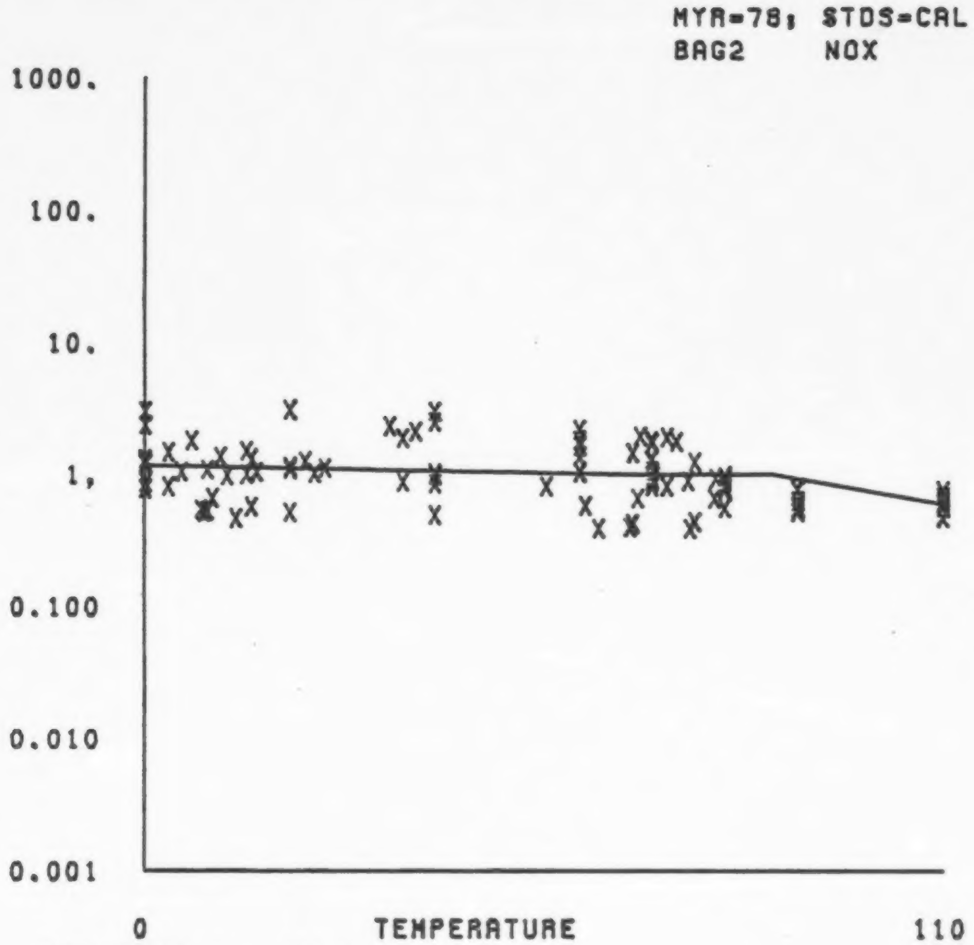
EXHIBIT 4.59

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 77FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.6611
5.0	1.5999
10.0	1.5408
15.0	1.4840
20.0	1.4292
25.0	1.3765
30.0	1.3257
35.0	1.2768
40.0	1.2297
45.0	1.1843
50.0	1.1406
55.0	1.0985
60.0	1.0580
65.0	1.0190
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9471
95.0	0.8763
100.0	0.8108
105.0	0.7502
110.0	0.6941

EXHIBIT 4.60



```
MIN TEMP = . -3.8
MAX TEMP = 110.00

N(LOW TEMP) 57            STD ERROR(LOW TEMP)    54.19%
N(FTP TEMP) 28            STD ERROR(FTP TEMP)    44.67%
N(HIGHTEMP) 12            STD ERROR(HIGHTEMP)    27.53%

    EFFECT(LOW TEMP)  = EXP(-0.002264(TEMP-67.5))
    EFFECT(HIGHTEMP)  = EXP(-0.022355(TEMP-88.5))
```

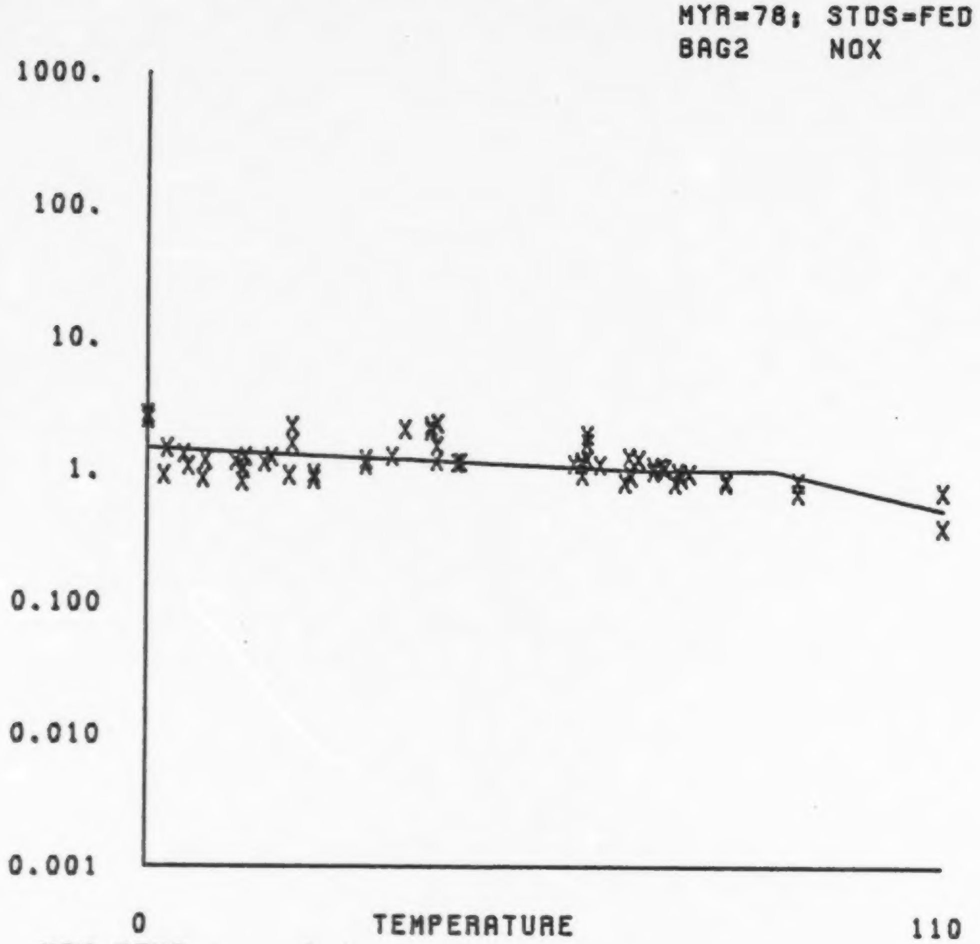
EXHIBIT 4.61

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 78CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.1651
5.0	1.1520
10.0	1.1390
15.0	1.1262
20.0	1.1135
25.0	1.1010
30.0	1.0886
35.0	1.0763
40.0	1.0642
45.0	1.0523
50.0	1.0404
55.0	1.0287
60.0	1.0171
65.0	1.0057
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9247
95.0	0.8269
100.0	0.7395
105.0	0.6613
110.0	0.5914

EXHIBIT 4.62



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 42                STD ERROR(LOW TEMP)     32.80%
N(FTP TEMP) 11                STD ERROR(FTP TEMP)     15.96%
N(HIGHTEMP) 4                 STD ERROR(HIGHTEMP)     26.35%

     EFFECT(LOW TEMP)  = EXP(-0.005626(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.029417(TEMP-86.5))
```

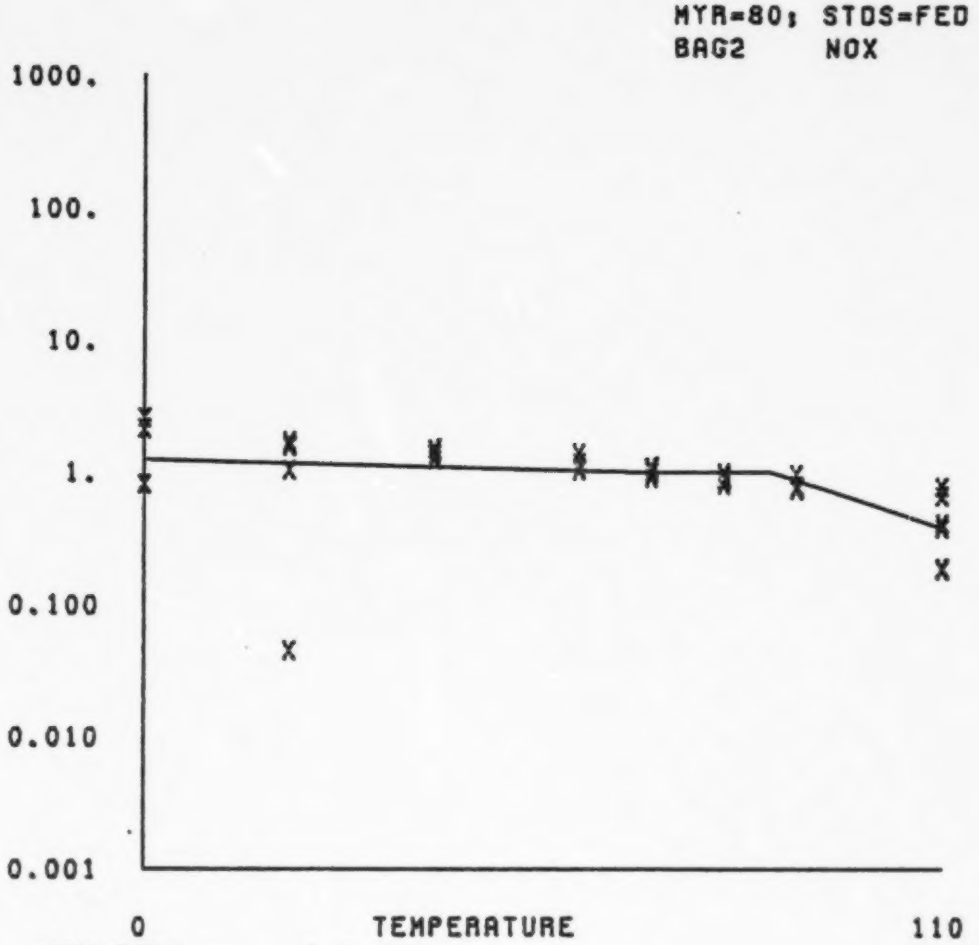
EXHIBIT 4.63

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 78FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.4619
5.0	1.4214
10.0	1.3820
15.0	1.3436
20.0	1.3063
25.0	1.2701
30.0	1.2349
35.0	1.2006
40.0	1.1673
45.0	1.1349
50.0	1.1035
55.0	1.0729
60.0	1.0431
65.0	1.0142
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9022
95.0	0.7788
100.0	0.6722
105.0	0.5803
110.0	0.5009

EXHIBIT 4.64



MIN TEMP = 0.0
MAX TEMP = 110.00

N(LOW TEMP)	17	STD ERROR(LOW TEMP)	85.80%
N(FTP TEMP)	11	STD ERROR(FTP TEMP)	11.50%
N(HIGHTEMP)	10	STD ERROR(HIGHTEMP)	43.64%

EFFECT(LOW TEMP) = EXP(-0.003032(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(-0.041623(TEMP-86.5))

EXHIBIT 4.65

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG2 OF NOX 80FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.2271
5.0	1.2086
10.0	1.1905
15.0	1.1725
20.0	1.1549
25.0	1.1375
30.0	1.1204
35.0	1.1036
40.0	1.0870
45.0	1.0706
50.0	1.0545
55.0	1.0386
60.0	1.0230
65.0	1.0076
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.8644
95.0	0.7020
100.0	0.5701
105.0	0.4630
110.0	0.3760

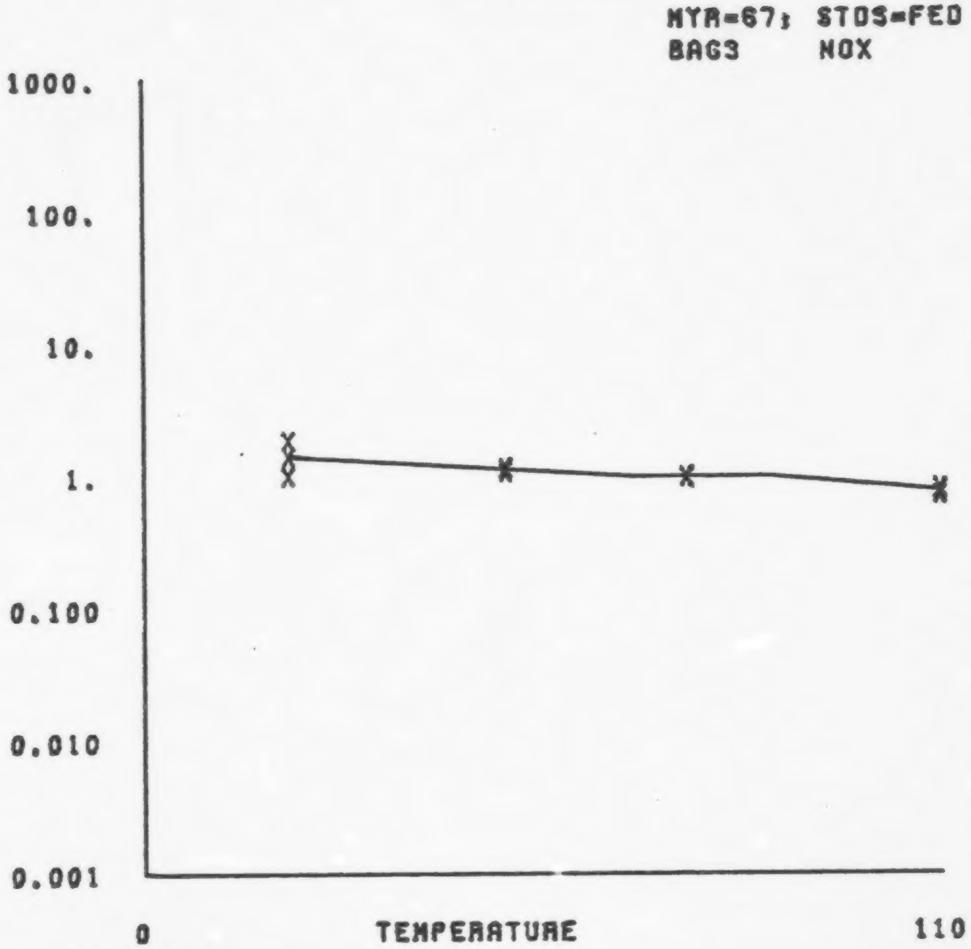
EXHIBIT 4.66: FITTED TEMPERATURE EFFECTS, NO_x BAG3

$$\frac{\text{EMISSIONS AT TEMPERATURE T}}{\text{EMISSIONS AT FTP TEMPERATURE}} = \begin{cases} \exp[c(T-67.5)] \text{ for T less than 67.5} \\ \exp[d(T-86.5)] \text{ for T greater than 86.5} \end{cases}$$

where exp is the exponential function and c and d are as tabled below.

MYR STDS	c	d
67FED	-.00725797	-.01083927
69FED	-.00610934	-.00479804
70FED	-.00763215	-.00677518
71FED	-.00656072	-.00230540
72FED	-.00580016	-.02784071
73FED	-.00727014	-.01087632
74FED	.00008766	-.02072568
75CAL	.00114997	-.12305805
75FED	.00235049	-.00754744
76FED	-.00780956	NO DATA
77CAL	-.00526984	-.02881034
77FED	-.00655286	-.01767965
78CAL	-.00387472	-.02267073
78FED	-.00347476	-.03224049
80FED	-.00796668	-.03266474

EXHIBIT 4.67



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 6          STD ERROR(LOW TEMP)    18.23%
N(FTP TEMP) 3          STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 3          STD ERROR(HIGHTEMP)     5.25%

     EFFECT(LOW TEMP)  = EXP(-0.007258 (TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.010839 (TEMP-86.5))
```

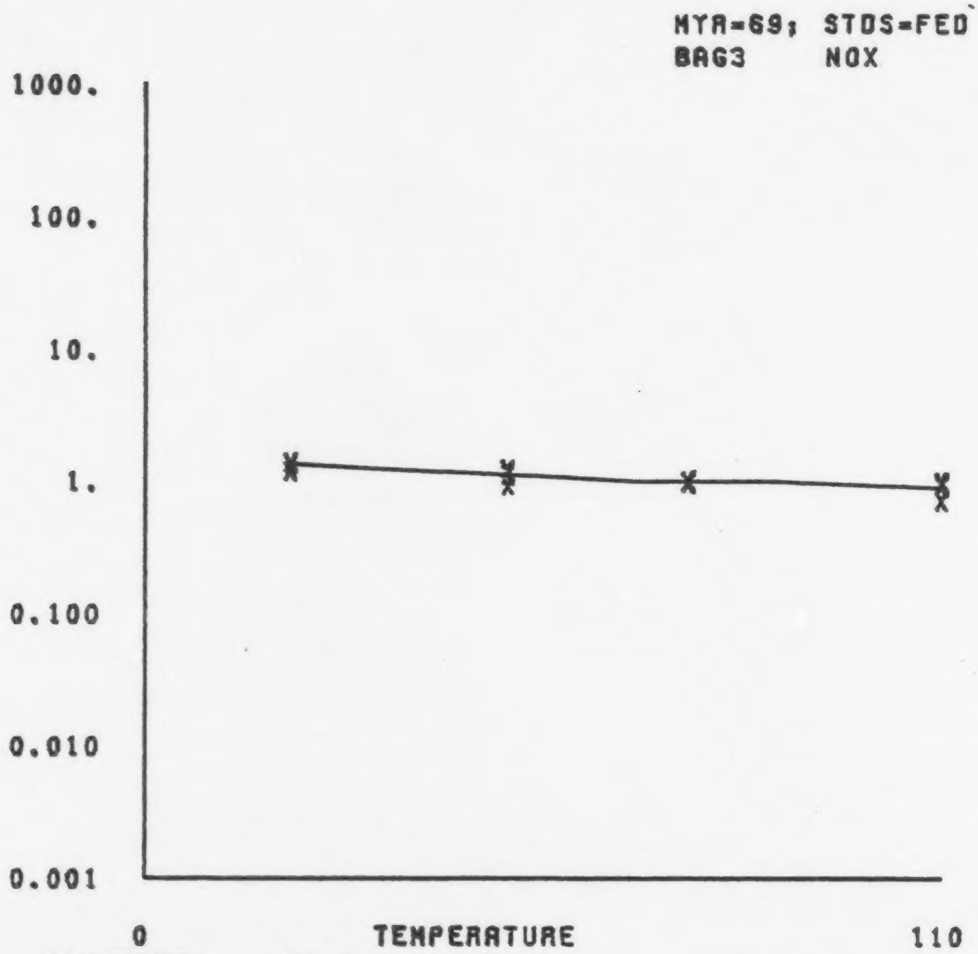
EXHIBIT 4.68

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 67FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.6322
5.0	1.5740
10.0	1.5179
15.0	1.4638
20.0	1.4116
25.0	1.3613
30.0	1.3128
35.0	1.2660
40.0	1.2209
45.0	1.1774
50.0	1.1354
55.0	1.0950
60.0	1.0559
65.0	1.0183
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9628
95.0	0.9120
100.0	0.8639
105.0	0.8183
110.0	0.7751

EXHIBIT 4.69 -



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 8              STD ERROR(LOW TEMP)     8.49%
N(FTP TEMP) 4              STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 4              STD ERROR(HIGHTEMP)    12.86%

    EFFECT(LOW TEMP)  = EXP(-0.006109(TEMP-67.5))
    EFFECT(HIGHTEMP)  = EXP(-0.004798(TEMP-86.5))
```

EXHIBIT 4.70

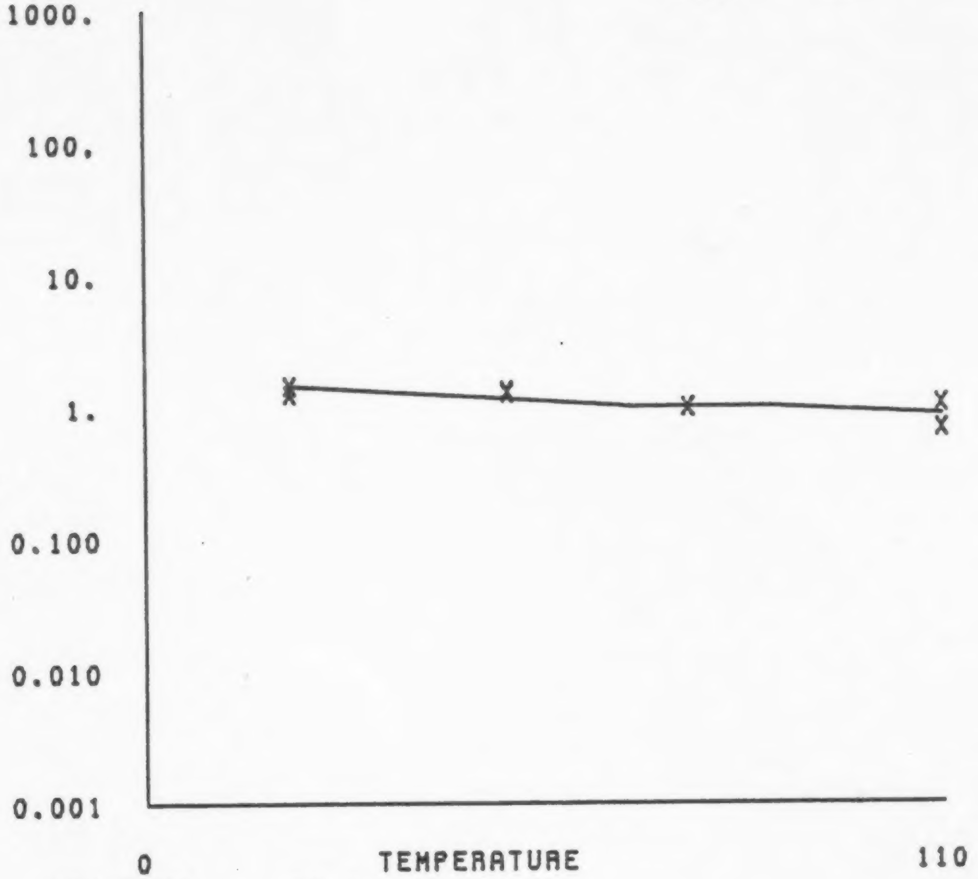
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 69FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.5104
5.0	1.4650
10.0	1.4209
15.0	1.3781
20.0	1.3367
25.0	1.2965
30.0	1.2575
35.0	1.2196
40.0	1.1829
45.0	1.1474
50.0	1.1128
55.0	1.0794
60.0	1.0469
65.0	1.0154
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9833
95.0	0.9600
100.0	0.9373
105.0	0.9151
110.0	0.8934

EXHIBIT 4.71

MYR=70; STDS=FED
BAG3 NOX



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 4            STD ERROR(LOW TEMP)    12.03%
N(FTP TEMP) 2            STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 2            STD ERROR(HIGHTEMP)    21.57%

     EFFECT(LOW TEMP)  = EXP(-0.007632(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.006775(TEMP-86.5))
```

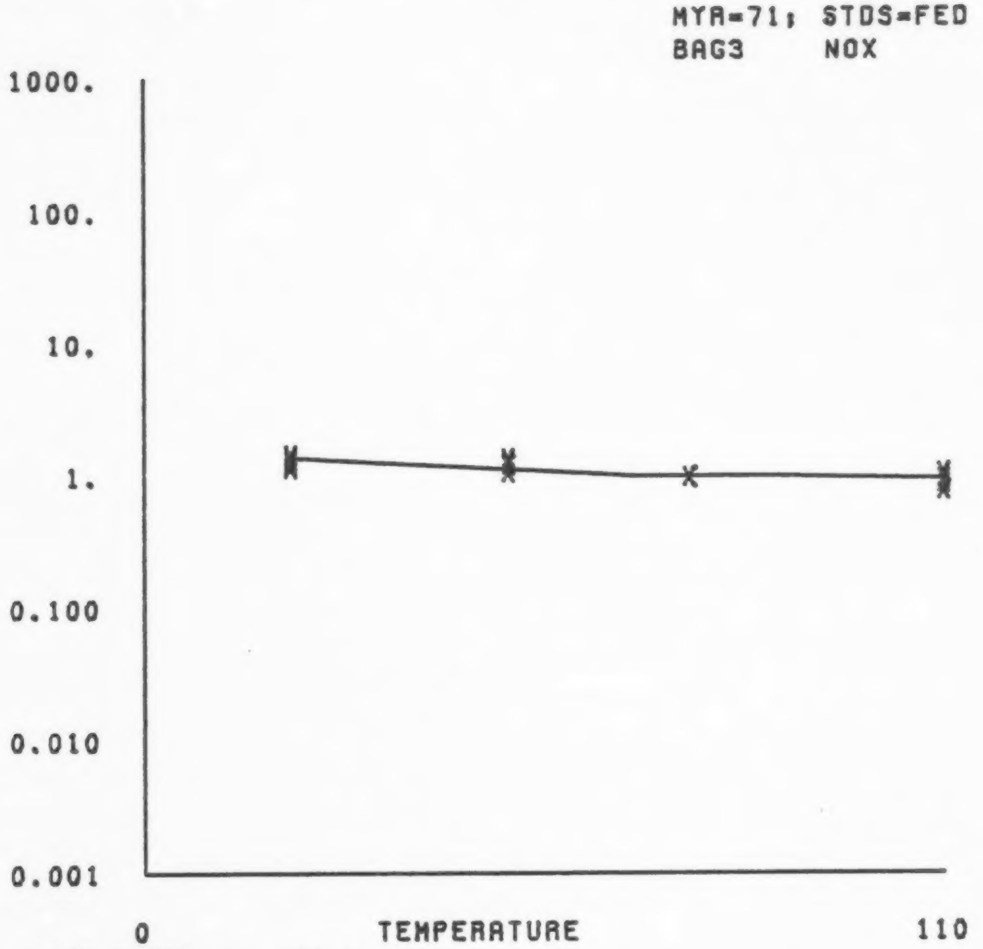
EXHIBIT 4.72

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 70FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.6739
5.0	1.6112
10.0	1.5509
15.0	1.4929
20.0	1.4370
25.0	1.3832
30.0	1.3314
35.0	1.2815
40.0	1.2335
45.0	1.1873
50.0	1.1429
55.0	1.1001
60.0	1.0589
65.0	1.0193
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9766
95.0	0.9440
100.0	0.9126
105.0	0.8822
110.0	0.8528

EXHIBIT 4.73



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 10          STD ERROR(LOW TEMP)    11.27%
N(FTP TEMP) 5           STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 5           STD ERROR(HIGHTEMP)    11.64%

     EFFECT(LOW TEMP) = EXP(-0.006561(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.002305(TEMP-86.5))
```

EXHIBIT 4.74

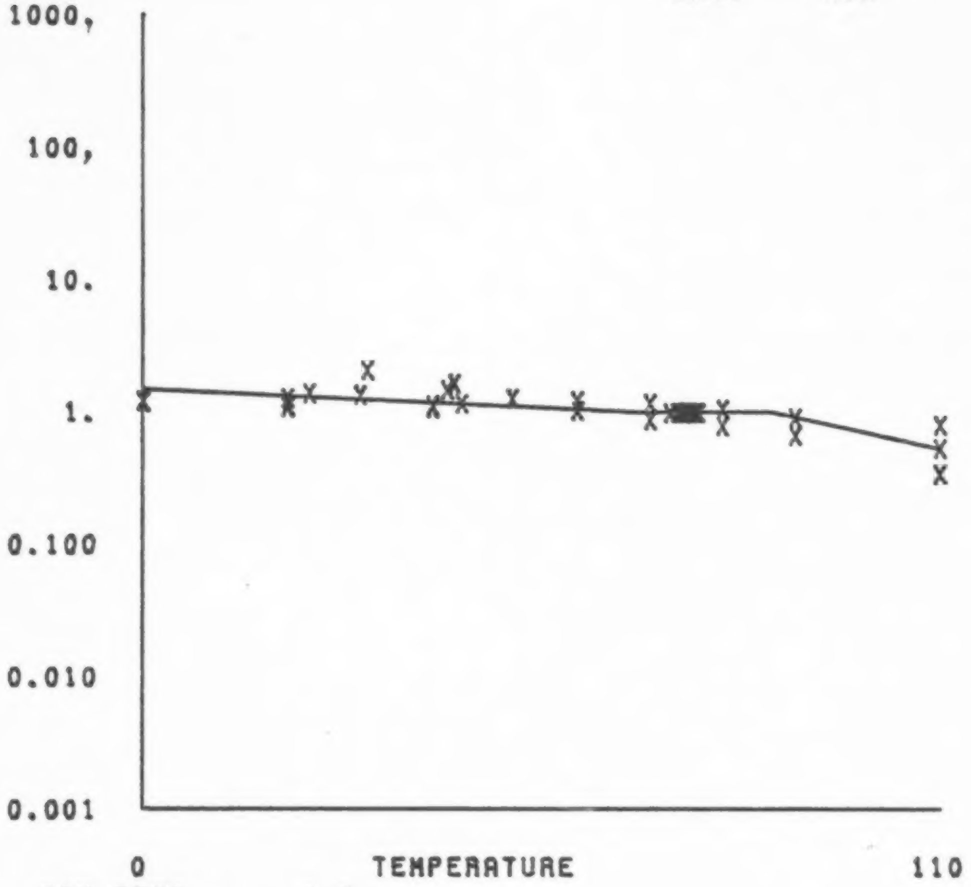
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 71FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.5571
5.0	1.5069
10.0	1.4583
15.0	1.4112
20.0	1.3657
25.0	1.3216
30.0	1.2789
35.0	1.2377
40.0	1.1977
45.0	1.1591
50.0	1.1217
55.0	1.0855
60.0	1.0504
65.0	1.0165
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9920
95.0	0.9806
100.0	0.9694
105.0	0.9582
110.0	0.9473

EXHIBIT 4.75

MYR=72; STDS=FED
BAG3 NOX



MIN TEMP = 0.0
MAX TEMP = 110.00

N(LOW TEMP)	16	STD ERROR(LOW TEMP)	20.38%
N(FTP TEMP)	12	STD ERROR(FTP TEMP)	18.37%
N(HIGHTEMP)	5	STD ERROR(HIGHTEMP)	30.15%

EFFECT(LOW TEMP) = EXP(-0.005800(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(-0.027841(TEMP-86.5))

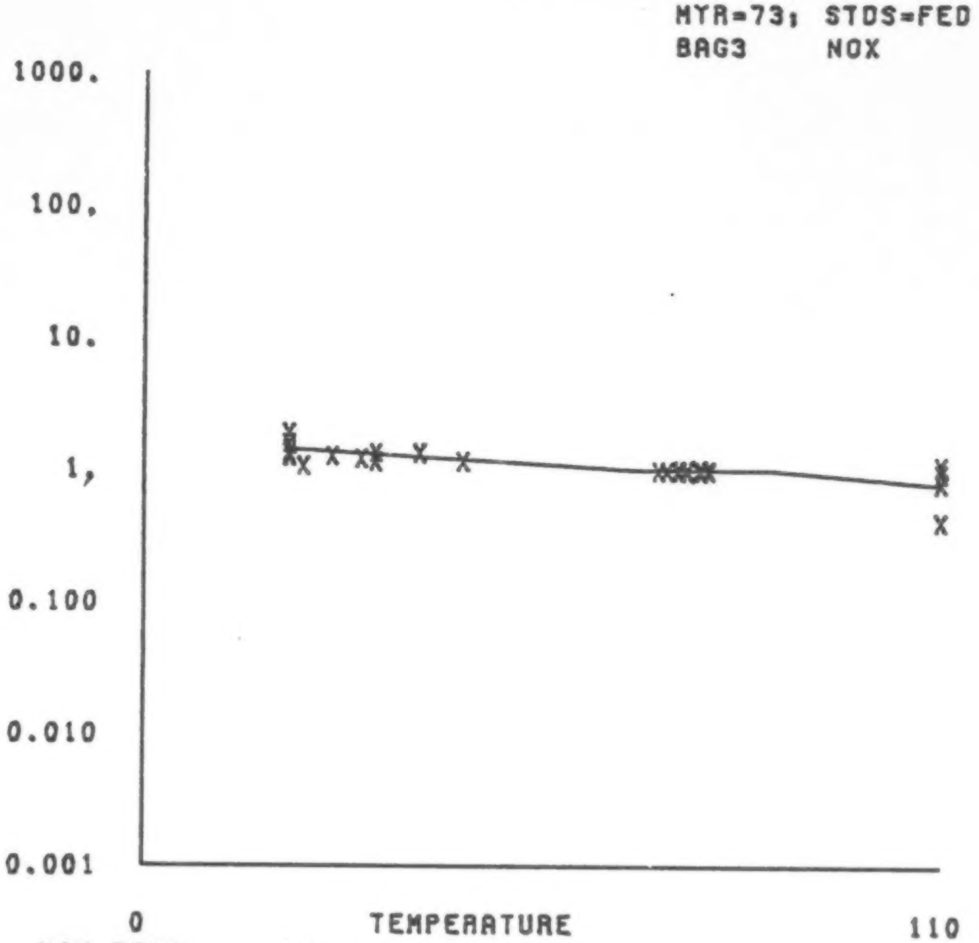
EXHIBIT 4.76

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 72FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.4792
5.0	1.4369
10.0	1.3959
15.0	1.3560
20.0	1.3172
25.0	1.2795
30.0	1.2430
35.0	1.2074
40.0	1.1729
45.0	1.1394
50.0	1.1068
55.0	1.0752
60.0	1.0445
65.0	1.0146
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9072
95.0	0.7893
100.0	0.6867
105.0	0.5975
110.0	0.5198

EXHIBIT 4.77



```
MIN TEMP =   20.0
MAX TEMP = 110.00

N(LOW TEMP) 12            STD ERROR(LOW TEMP)    13.52%
N(FTP TEMP) 12            STD ERROR(FTP TEMP)     0.0 %
N(HIGHTEMP) 4             STD ERROR(HIGHTEMP)    37.75%

     EFFECT(LOW TEMP)  = EXP(-0.007270 (TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.010876 (TEMP-86.5))
```

EXHIBIT 4.78

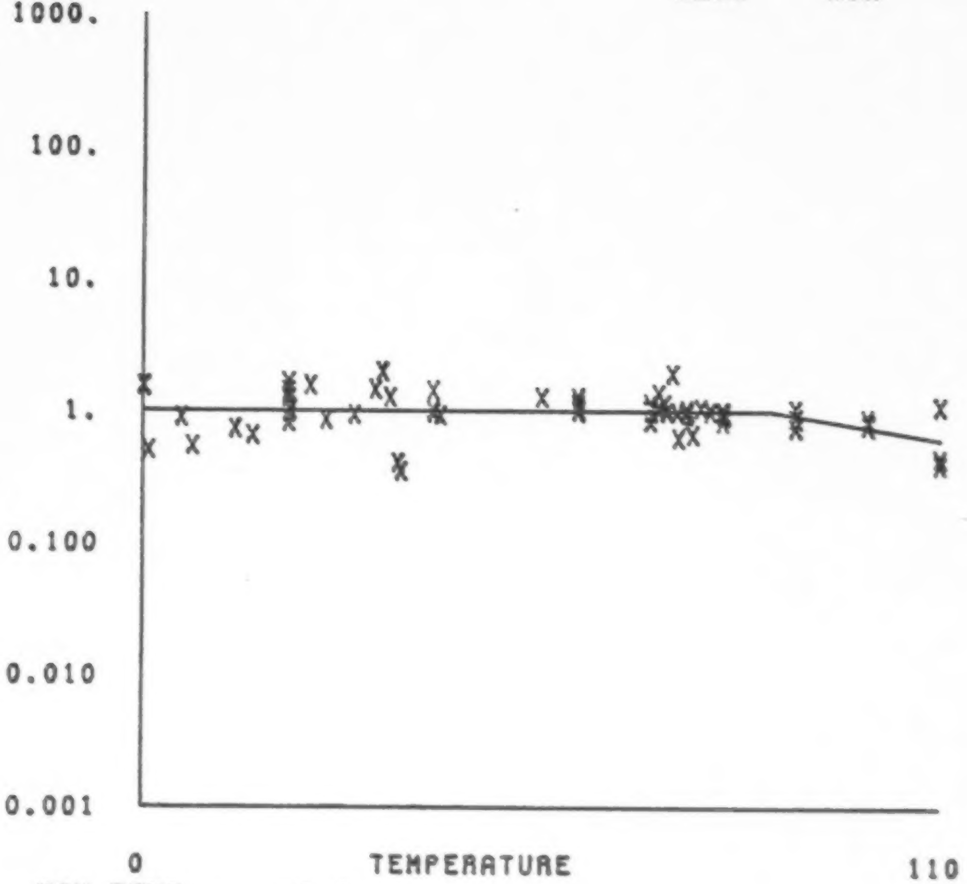
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 73FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.6335
5.0	1.5752
10.0	1.5190
15.0	1.4647
20.0	1.4125
25.0	1.3620
30.0	1.3134
35.0	1.2665
40.0	1.2213
45.0	1.1777
50.0	1.1357
55.0	1.0951
60.0	1.0560
65.0	1.0183
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9626
95.0	0.9117
100.0	0.8634
105.0	0.8177
110.0	0.7745

EXHIBIT 4.79

MYR=74; STDS=FED
BAG3 NOX



MIN TEMP = -6.9
MAX TEMP = 110.00

N(LOW TEMP)	36	STD ERROR(LOW TEMP)	37.78%
N(FTP TEMP)	28	STD ERROR(FTP TEMP)	26.69%
N(HIGHTEMP)	12	STD ERROR(HIGHTEMP)	24.91%

EFFECT(LOW TEMP) = EXP(0.000088(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(-0.020726(TEMP-86.5))

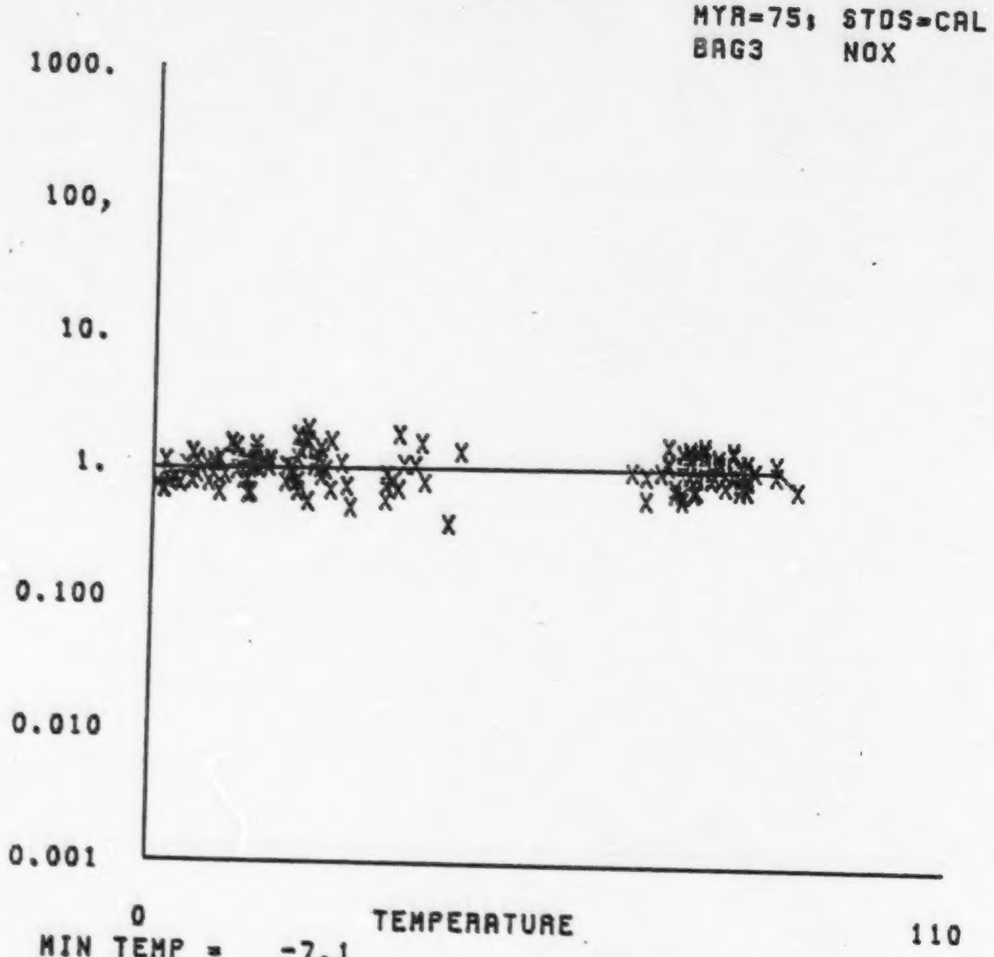
EXHIBIT 4.80

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 74FED

TEMP. (°F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9941
5.0	0.9945
10.0	0.9950
15.0	0.9954
20.0	0.9958
25.0	0.9963
30.0	0.9967
35.0	0.9972
40.0	0.9976
45.0	0.9980
50.0	0.9985
55.0	0.9989
60.0	0.9993
65.0	0.9998
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9300
95.0	0.8385
100.0	0.7559
105.0	0.6815
110.0	0.6144

EXHIBIT 4.81



MIN TEMP = -7.1
MAX TEMP = 89.00

N(LOW TEMP) 91
N(FTP TEMP) 54
N(HIGHTEMP) 1

STD ERROR(LOW TEMP) 30.02%
STD ERROR(FTP TEMP) 24.19%
STD ERROR(HIGHTEMP) 0.0 %

EFFECT(LOW TEMP) = EXP(0.001150(TEMP-67.5))
EFFECT(HIGHTEMP) = EXP(-0.123058(TEMP-88.5))

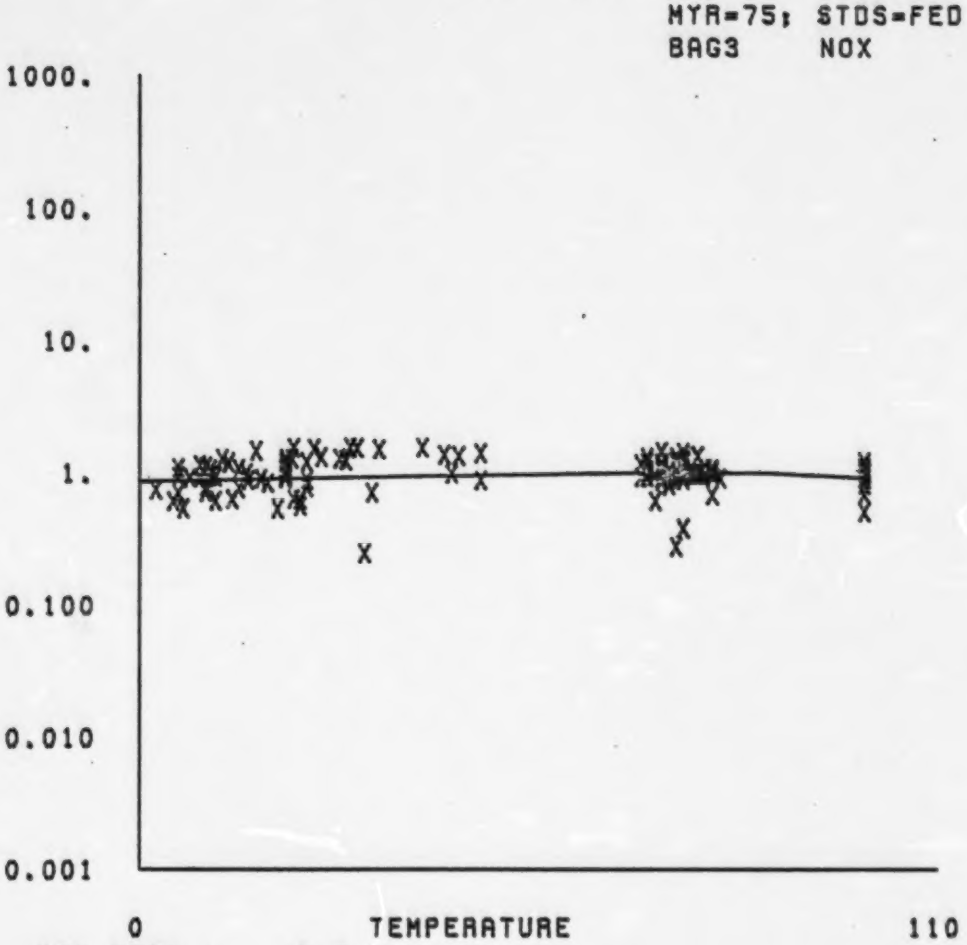
EXHIBIT 4.82

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 75CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.9253
5.0	0.9306
10.0	0.9360
15.0	0.9414
20.0	0.9468
25.0	0.9523
30.0	0.9578
35.0	0.9633
40.0	0.9689
45.0	0.9745
50.0	0.9801
55.0	0.9857
60.0	0.9914
65.0	0.9971
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.6501
95.0	0.3513
100.0	0.1899
105.0	0.1026
110.0	0.0555

EXHIBIT 4.83



```
MIN TEMP =    -5.8
MAX TEMP = 100.00

N(LOW TEMP) 88              STD ERROR(LOW TEMP)    37.22%
N(FTP TEMP) 62              STD ERROR(FTP TEMP)    34.06%
N(HIGHTEMP) 9               STD ERROR(HIGHTEMP)    25.35%

     EFFECT(LOW TEMP)  = EXP( 0.002350(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.007547(TEMP-86.5))
```

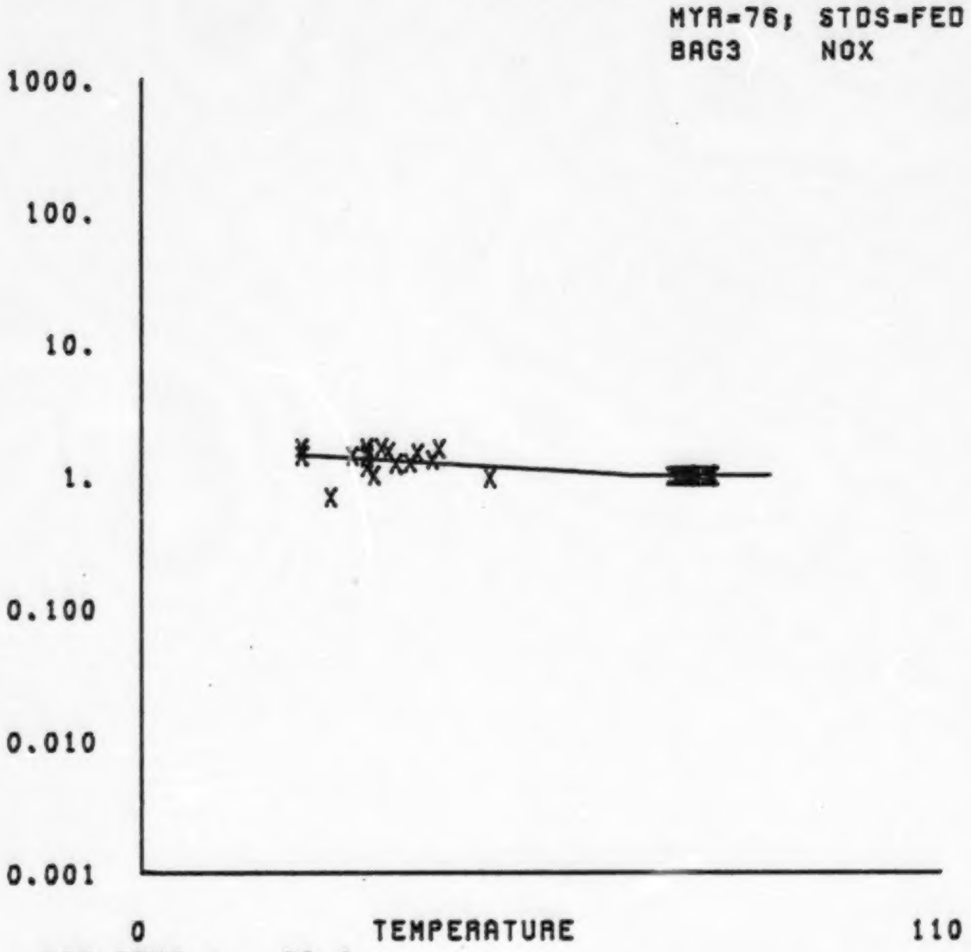
EXHIBIT 4.84

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 75FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	0.8533
5.0	0.8634
10.0	0.8736
15.0	0.8839
20.0	0.8944
25.0	0.9049
30.0	0.9156
35.0	0.9265
40.0	0.9374
45.0	0.9485
50.0	0.9597
55.0	0.9710
60.0	0.9825
65.0	0.9941
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9739
95.0	0.9379
100.0	0.9031
105.0	0.8697
110.0	0.8375

EXHIBIT 4.85



MIN TEMP = 22.0
MAX TEMP = 78.70

N(LOW TEMP)	19	STD ERROR(LOW TEMP)	21.22%
N(FTP TEMP)	19	STD ERROR(FTP TEMP)	0.0 %
N(HIGHTEMP)	0	STD ERROR(HIGHTEMP)	0.0 %

EFFECT(LOW TEMP) = EXP(-0.007810(TEMP-67.5))

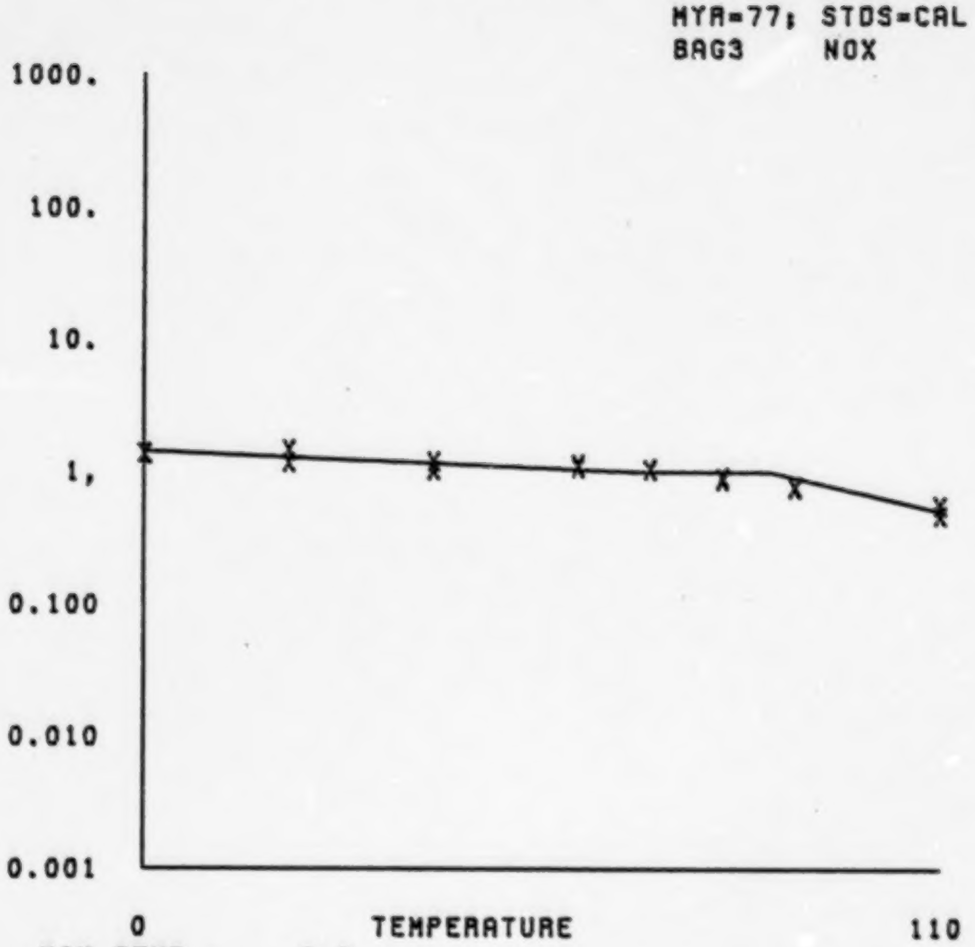
EXHIBIT 4.86

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 76FED

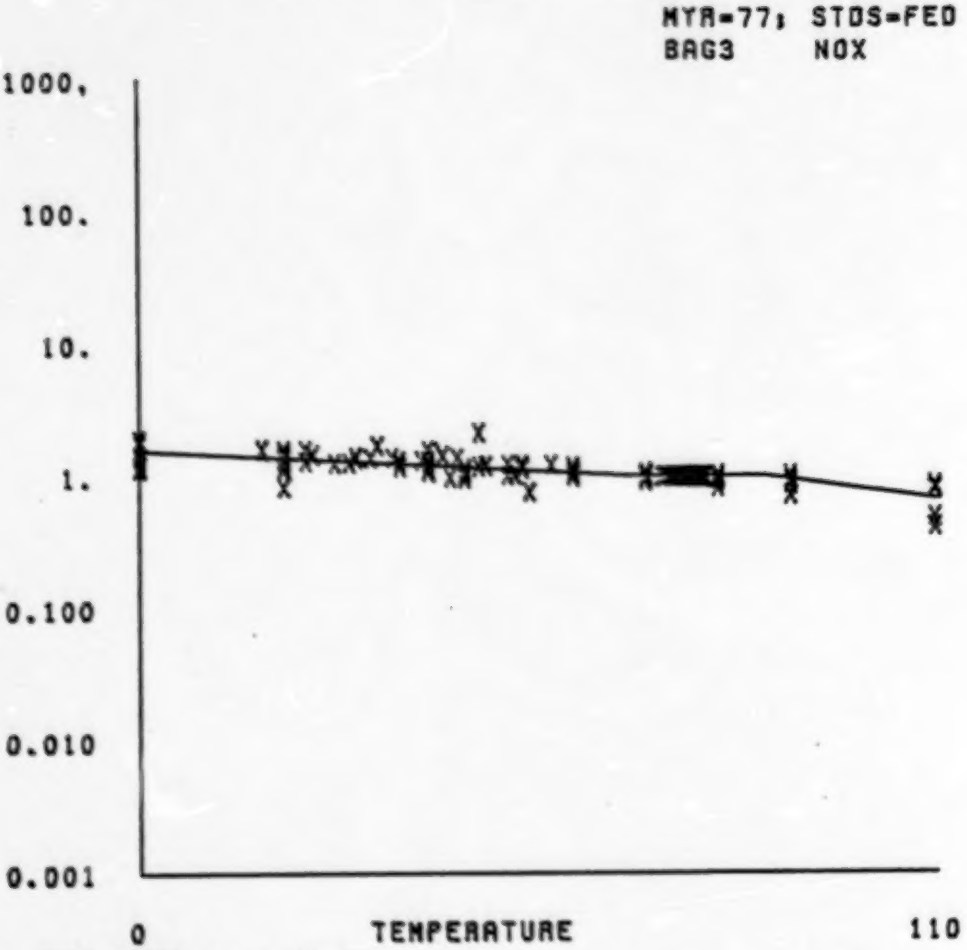
TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.6941
5.0	1.6292
10.0	1.5668
15.0	1.5068
20.0	1.4491
25.0	1.3936
30.0	1.3403
35.0	1.2889
40.0	1.2396
45.0	1.1921
50.0	1.1464
55.0	1.1025
60.0	1.0603
65.0	1.0197
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	**No data**
95.0	" "
100.0	" "
105.0	" "
110.0	" "

EXHIBIT 4.87



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 8                STD ERROR(LOW TEMP)     8.63%
N(FTP TEMP) 4                STD ERROR(FTP TEMP)     9.56%
N(HIGHTEMP) 4                STD ERROR(HIGHTEMP)    12.59%

      EFFECT(LOW TEMP) = EXP(-0.005270(TEMP-67.5))
      EFFECT(HIGHTEMP) = EXP(-0.028810(TEMP-86.5))
```

EXHIBIT 4.89



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 65              STD ERROR(LOW TEMP)    16.71%
N(FTP TEMP) 48              STD ERROR(FTP TEMP)     7.55%
N(HIGHTEMP) 12              STD ERROR(HIGHTEMP)    23.23%

     EFFECT(LOW TEMP) = EXP(-0.006553(TEMP-67.5))
     EFFECT(HIGHTEMP) = EXP(-0.017680(TEMP-86.5))
```

EXHIBIT 4.88

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX   77CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.4272
5.0	1.3901
10.0	1.3539
15.0	1.3187
20.0	1.2844
25.0	1.2510
30.0	1.2185
35.0	1.1868
40.0	1.1559
45.0	1.1259
50.0	1.0966
55.0	1.0681
60.0	1.0403
65.0	1.0133
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9041
95.0	0.7828
100.0	0.6778
105.0	0.5868
110.0	0.5081

EXHIBIT 4.90

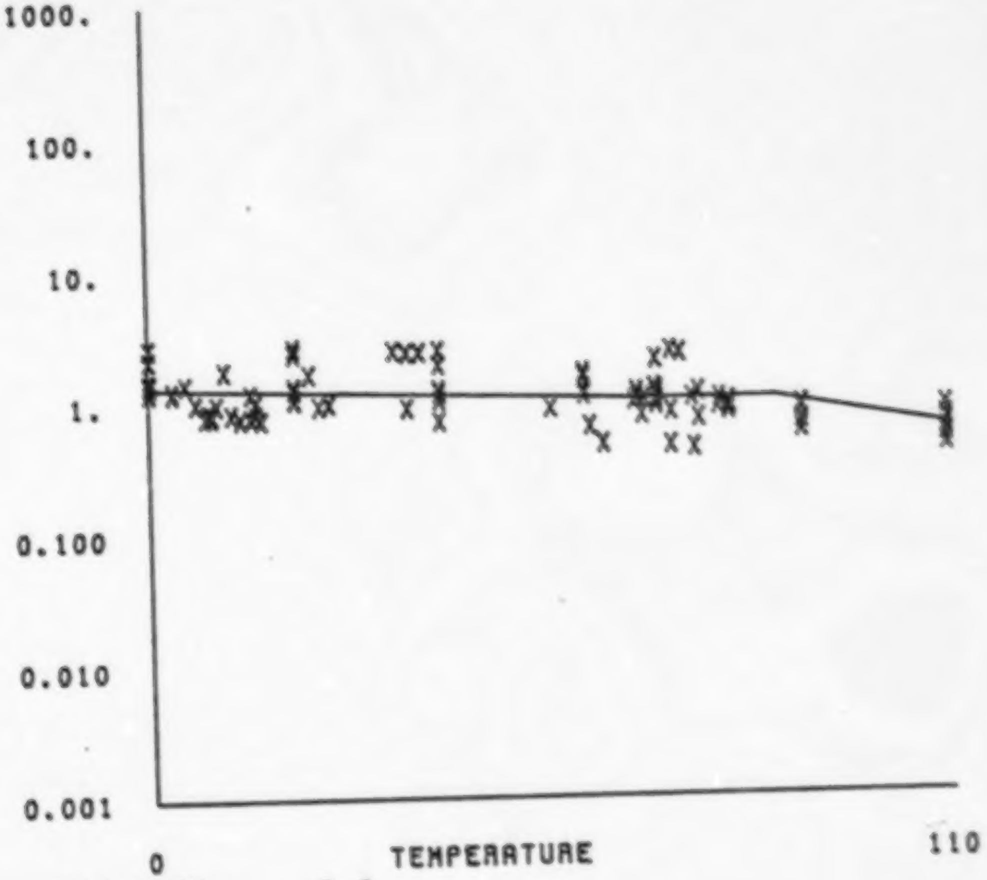
TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 77FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.5563
5.0	1.5061
10.0	1.4576
15.0	1.4106
20.0	1.3651
25.0	1.3211
30.0	1.2786
35.0	1.2373
40.0	1.1975
45.0	1.1589
50.0	1.1215
55.0	1.0854
60.0	1.0504
65.0	1.0165
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9400
95.0	0.8605
100.0	0.7877
105.0	0.7210
110.0	0.6600

EXHIBIT 4.91

MYR=78; STDS=CAL
BAG3 NOX



```
MIN TEMP =   -3.8
MAX TEMP = 110.00

N (LOW TEMP) 57                    STD ERROR (LOW TEMP)     39.24%
N (FTP TEMP) 29                    STD ERROR (FTP TEMP)     39.05%
N (HIGHTEMP) 12                    STD ERROR (HIGHTEMP)     22.93%

       EFFECT (LOW TEMP)  = EXP (-0.003875 (TEMP-67.5))
       EFFECT (HIGHTEMP)  = EXP (-0.022671 (TEMP-88.5))
```

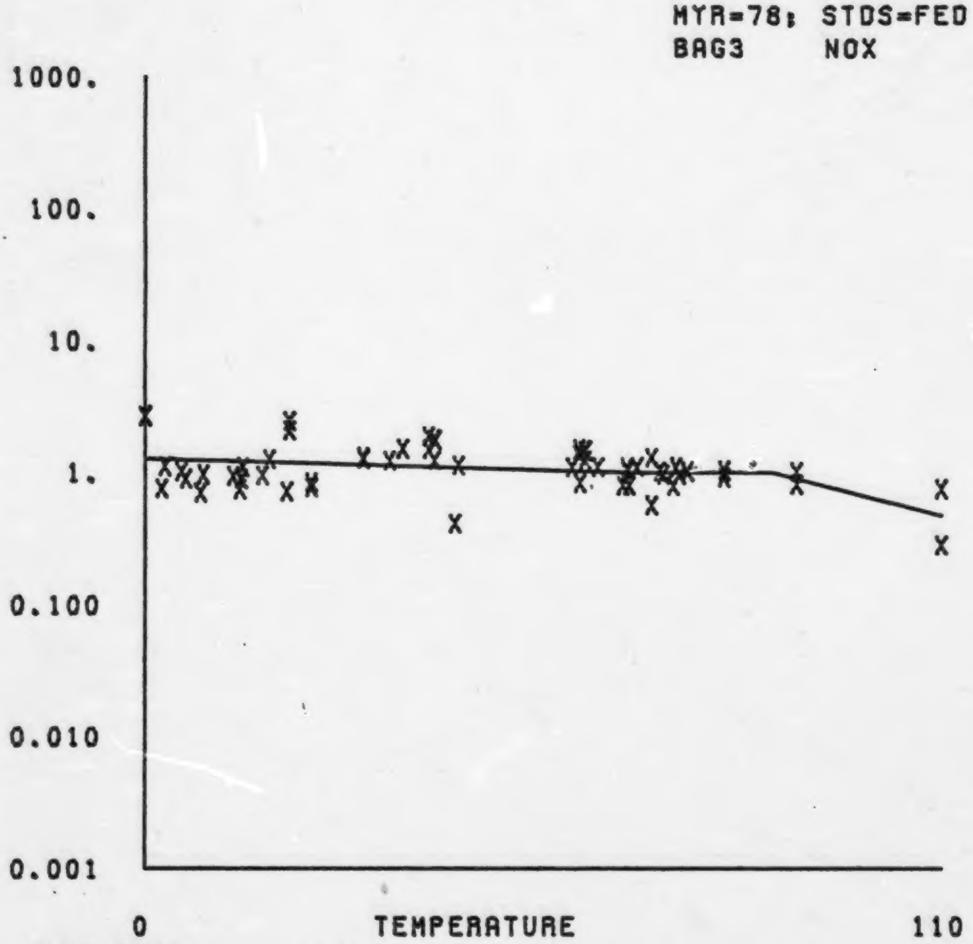
EXHIBIT 4.92

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX   78CAL

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.2989
5.0	1.2740
10.0	1.2496
15.0	1.2256
20.0	1.2021
25.0	1.1790
30.0	1.1564
35.0	1.1342
40.0	1.1124
45.0	1.0911
50.0	1.0702
55.0	1.0496
60.0	1.0295
65.0	1.0097
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.9237
95.0	0.8247
100.0	0.7363
105.0	0.6574
110.0	0.5870

EXHIBIT 4.93



MIN TEMP = 0.0
MAX TEMP = 110.00

N (LOW TEMP)	42	STD ERROR (LOW TEMP)	39.04%
N (FTP TEMP)	11	STD ERROR (FTP TEMP)	25.78%
N (HIGHTEMP)	4	STD ERROR (HIGHTEMP)	35.59%

EFFECT (LOW TEMP) = EXP (-0.003475 (TEMP-67.5))
EFFECT (HIGHTEMP) = EXP (-0.032240 (TEMP-86.5))

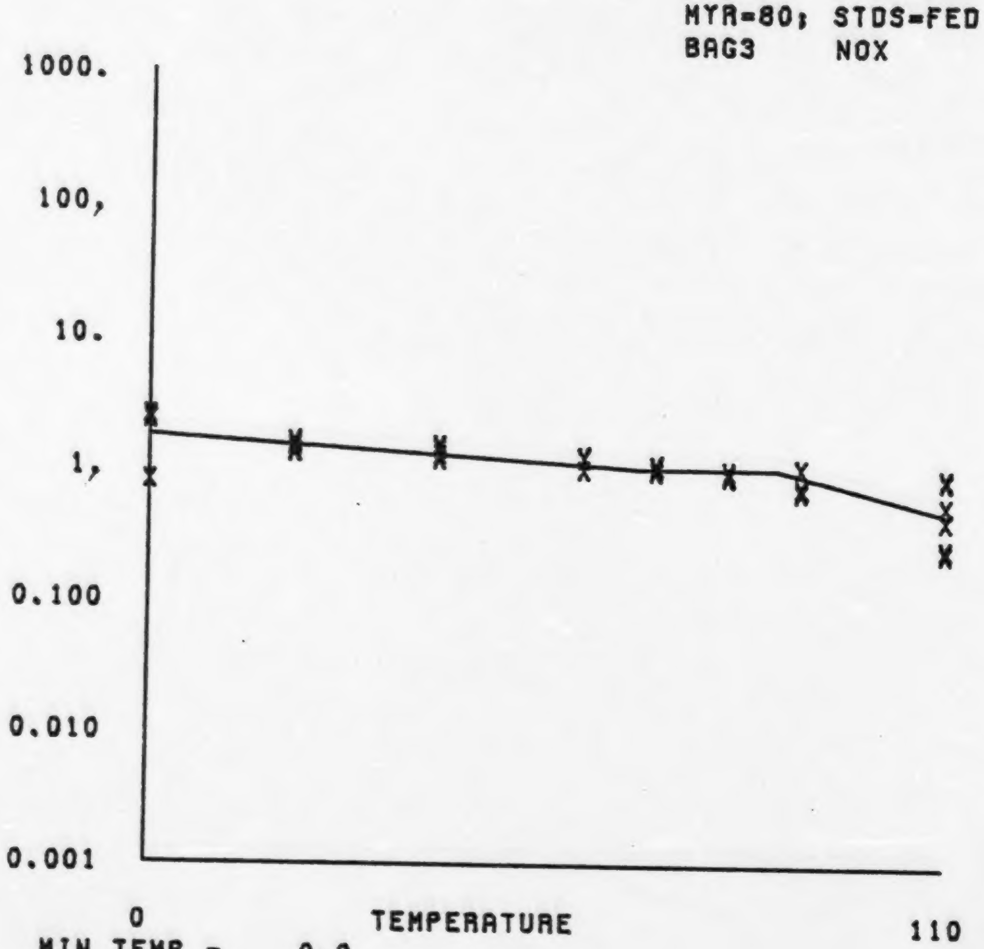
EXHIBIT 4.94

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 78FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.2643
5.0	1.2426
10.0	1.2212
15.0	1.2001
20.0	1.1795
25.0	1.1591
30.0	1.1392
35.0	1.1196
40.0	1.1003
45.0	1.0813
50.0	1.0627
55.0	1.0444
60.0	1.0264
65.0	1.0087
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.8933
95.0	0.7603
100.0	0.6471
105.0	0.5508
110.0	0.4688

EXHIBIT 4.95



```
MIN TEMP =    0.0
MAX TEMP = 110.00

N(LOW TEMP) 17              STD ERROR(LOW TEMP)    23.79%
N(FTP TEMP) 11              STD ERROR(FTP TEMP)     8.36%
N(HIGHTEMP) 10              STD ERROR(HIGHTEMP)    42.00%

     EFFECT(LOW TEMP)  = EXP(-0.007967(TEMP-67.5))
     EFFECT(HIGHTEMP)  = EXP(-0.032665(TEMP-86.5))
```

EXHIBIT 4.96

TABLE OF ESTIMATED TEMPERATURE EFFECTS

BAG3 OF NOX 80FED

TEMP. (F)	RATIO OF EMISSIONS TO FTP-TEMP. EMISSIONS
0.0	1.7122
5.0	1.6453
10.0	1.5810
15.0	1.5193
20.0	1.4600
25.0	1.4030
30.0	1.3482
35.0	1.2955
40.0	1.2449
45.0	1.1963
50.0	1.1496
55.0	1.1047
60.0	1.0616
65.0	1.0201
70.0	1.0000
75.0	1.0000
80.0	1.0000
85.0	1.0000
90.0	0.8920
95.0	0.7576
100.0	0.6434
105.0	0.5465
110.0	0.4641

5.0 PREDICTING EMISSIONS USING TEMPERATURE AND OTHER CORRECTIONS

The basic use for the temperature correction factors derived in this report is in the estimation of the emissions of a possible fleet of in-use vehicles in a driving scenario involving temperatures other than those used in the FTP test. It is frequently important to make this estimate for scenarios involving other differences from the FTP assumptions, including differences in assumptions concerning vehicle speeds and/or the percentages of mileage driven under conditions similar to those of Bag 1, Bag 2, and Bag 3 of the FTP. Producing overall correction formulae appropriate to this use involves combining the temperature correction formulae obtained in the earlier sections with emissions estimates for vehicles of various years and with correction factors for vehicle speed and deterioration factors related to vehicle age and mileage. Specifically, either of the two general forms given in exhibit 5.1 would be suitable for this use. The difference between the forms is the assumptions used to relate the temperature correction to the age/mileage deterioration. The first alternative assumes that the temperature correction should be applied to the deteriorated emissions; the second alternative assumes that the deterioration adds temperature-independent amounts of emissions, so that the increases in emissions from aging and from temperature effects are additive, rather than temperature producing a multiplicative change in all emissions from a vehicle.

EXHIBIT 5.1: CORRECTION FACTOR FORMULATION

FIRST ALTERNATIVE:

$$\text{EMISSIONS} = \sum_{y} U_y \; CF_{b,y,T,s} \; E_{b,y,A}$$

Where

$$E \text{ (uncorrected emissions)} = \sum_{b} (e_{b,y} + d_{b,y} A) M_b$$

$$CF \text{ (correction factor)} = \frac{\sum_{b} f_b \exp(c_{b,y,r}(T-F_r))_o (e_{b,y} + d_{b,y} A) V_{b,y,s}}{\sum_{b} (e_{b,y} + d_{b,y} A) M_b}$$

and other symbols are as on facing page.

SECOND ALTERNATIVE:

$$\text{EMISSIONS} = \sum_{y} U_y \; \hat{CF}_{b,y,T,s,A} \; E_{b,y,A}$$

with

$$CF_{b,y,T,s,A} = \frac{\sum_{b} f_b (e_{b,y} \exp(c_{b,y,r}(T-F_r)) + d_{b,y} A) V_{b,y,s}}{\sum_{b} (e_{b,y} + d_{b,y} A) M_b}$$

EXHIBIT 5.1 CONTINUED

Where

U_y	is the expected vehicle miles usage of vehicles of model-year standards combination y at or near temperature T
f_b	is the fraction of this driving which is similar to that in bag b of the Federal Test Procedure
$c_{b,y,r}$	is the temperature response coefficient fitted in the first three chapters of this report, where b is the bag, y the model-year-standards group, and r the temperature range (above or below the FTP temperature range)
F_r	is the appropriate endpoint of the FTP temperature range (67.5° for the below-FTP cases, 86.5° for the above-FTP cases)
$e_{b,y}$	is the estimated low mileage, FTP-test emissions for the vehicles in class y on bag b
$d_{b,y}$	is the estimated deterioration factor for vehicle in class y on bag b emissions
A	is the vehicle age/mileage, in 10,000 mile "years"
$V_{b,y,s}$	is the EPA correction for driving speed s
M_b	is the fraction of FTP mileage in bag b.

Either of these forms of predictive equation may be used in an alternative form in which one directly estimates emissions corrected for temperature and other effects, without an explicit computation of a multiplicative correction factor. These forms of the equations are shown in exhibit 5.2.

EXHIBIT 5.2: PREDICTING TOTAL EMISSIONS

FIRST ALTERNATIVE:

$$\text{EMISSIONS} = \sum_{y} U_y \sum_{b} f_b \exp(c_{b,y,r}(T-F_r))(e_{b,y} + d_{b,y}A)V_{b,y,s}$$

SECOND ALTERNATIVE:

$$\text{EMISSIONS} = \sum_{y} U_y \sum_{b} f_b(e_{b,y}\exp(c_{b,y,r}(T-F_r)) + d_{b,y}A)V_{b,y,s}$$

Where the symbols are as in exhibit 5.1.

APPENDIX A

As described in text, the statistical analyses used in this analysis were divided into three groups: those used to determine which bags of which pollutants had temperature effects, those used to determine whether model-year and standards effects were present, and those used to estimate the parameters of the temperature correction formula. This appendix contains brief individual sections describing the methods used in each area.

Before performing any of the main analyses, preliminary data reduction steps were taken. The first of these was the elimination of mileage (deterioration) effects in the results from the two Canadian data sets, in which tests of a single vehicle were spaced over several thousands of miles. These effects were eliminated by determining a linear deterioration regression for each vehicle based on the measurements available in the FTP temperature range. This least-squares deterioration factor was then used to adjust all the emissions data for the vehicle involved in the same way as EPA deterioration factors are generally used. Following this step, logarithms were taken and each vehicle's data adjusted to measure the logarithm of the ratio between a particular test result and the average of that vehicle's results at FTP temperatures. (These adjustments are also described in appendix B.)

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A.1 DETERMINING WHETHER TEMPERATURE EFFECTS EXIST

As noted in text, the high-temperature and low-temperature measurements for each bag of each pollutant were compared, using the Kolmogorov-Smirnov test of distributional identity, to determine whether distributional differences (temperature effects) were present. In the single case where no differences were detected with this test, both groups were tested to find out if their means and medians were zero, as would be expected if there were no temperature effects. Both groups failed the median test at the 1% level, and failed a non-parametric test of the mean based on Chebychev's inequality at the 1% and 4% levels.

All the tests chosen for this purpose were non-parametric, rather than the perhaps more usual normal-distribution tests, because it was desired to make the determination of the existence of a temperaure effect without any assumptions concerning distribution.

As is described in the appendix on the data sources, these preliminary tests were conducted on a data set which included five vehicles and some additional tests of other vehicles which were eliminated from the study data base before the final correction factors were fitted. Since these initial analyses were only used to guide the selection of the general forms for fitting, they were not repeated after the (fairly small) reduction in the data base.

A.2 DETERMINING WHETHER MODEL-YEAR AND STANDARDS EFFECTS EXIST

In the process of fitting equations to the temperature effects data, general linear model techniques were used to examine the potential adequacy of models of the form

$$\log \text{effect} = (c+c'+c''+c''')(T-F),$$

where F is the relevant edge of the FTP temperature range and c is assumed to be constant, c' to vary with model year, c'' with model-year and standards, and c''' with other factors. Even though the data and the residuals were not distributed normally, standard normal-distribution theory F-tests were used to estimate the presence or absence of model-year and model-year-standards effects. The tests were made at the 10% significant level, and more than one-half the bags had model-year-standards effects by this rule. (No suitable non-parametric tests were available to examine this question.)

The c''' term was used to examine two questions: the first was whether the apparent model-year-standards effects could be being produced by a data source effect, since data source was highly correlated with model year and somewhat correlated with standards. The result of this analysis, in which model-year-standards effects were looked for in the presence of a data-source effect, was that model-year-standards effects on the temperature response were still present. The c''' term was also used to examine whether or not additional, unexplained vehicle factors influenced the temperature response. F-tests of cases in which c''' was allowed to vary with vehicle rejected the hypothesis that model-year, standards, and data source alone determined temperature response: some additional, unexamined effect still differentiated the temperature response of the vehicles in the data base.

A.3 FITTING TEMPERATURE EFFECT EQUATIONS

The temperature effect equations for fitting were selected as the simplest analogs of the current temperature correction factors which could reasonably fit the observed temperature effects. The past factors had all involved log-linear relations between temperature and emissions, and this form was retained. On the other hand, the past fits had been linear over the entire temperature range, and the current data clearly showed the existence of U-shaped effects functions in at least some bags. Accordingly, a piecewise log-linear fitting procedure was adopted, in which linear functions were fitted separately for the low-temperature and high-temperature ranges, with the temperature response in the FTP range assumed zero.

Least-squares techniques were used to generate the fitted curves described in the main sections of this report. Because of the obvious non-normality of the data involved, no estimates of the errors in the coefficients are given: the descriptive statistics of the fit are the estimated mean square residual in each of the three temperature ranges (with the estimate in the FTP range allowing for the reduction in degrees of freedom due to the method used in generating the temperature effects data, as described in the main report). The FTP-range error is included to allow comparison with the error remaining after the linear fits in the other ranges, so that an idea of the adequacy of the file in all three ranges can be obtained.

The basic assumptions which have been made in the choice of fitting techniques are that the data set is representative of actual emissions effects, including the non-normality observed (even those observations which might be classed as outliers in normal-distribution methods, and that the observed data-source effects on estimates of temperature response represents real-world variations which are in the data in appropriate sampling frequencies. The existence of unexplained vehicle effects on temperature response would tend to indicate that more detailed study might generate more detailed estimating relations. Such relations are inappropriate for the present purpose, however, since the potential users of the correction equations generated here will not have data concerning the mix of vehicle characteristics in their fleets on any more detailed basis than model-year-standards groups.

APPENDIX B

The data for this study were taken from the compendium of data described in the report Data Base for the Development of Improved Temperature Correction Factors for Emissions (Report VRI-EPA-5 FR79-1, July, 1979), supplemented by data on 84 tests from the EPA Emission Factors Program which provide a paired dataset of normal-temperature measurements for the CH1 dataset of low-temperature measurements.

For use in fitting the correction factor formulae, portions of this overall data base (which contained 1608 tests in total) were removed as not being appropriate for the particular analysis involved. The removed portions were:

1) The AA1 data set, for which the soak and ambient test temperatures were dissimilar.
2) Cars built under Canadian emissions regulations for sale in Canada.
3) The single US-built prototype stratified-charge vehicle in the sample, which was not representative of actual US vehicles.
4) The two light-duty diesel automobiles in the data, which were too small a sample to generate diesel-specific corrections and which EPA decided should not be included with gasoline engines.
5) The three stratified-charge production vehicles in the data, which were an insufficient sample to generate stratified-charge-specific corrections, and which EPA decided should not be included with other gasoline engine types.
6) The four prototype vehicles built before model year 1980. (Model year 1980 prototypes were left in the sample, since no better data was available from production vehicles for that year.) These vehicles were eliminated after the initial examinations for the presence of temperature effects, but before any fitting of correction factor equations.
7) All tests in which the vehicle air-conditioner was known to have been operating, removed at the same time as the prototypes.

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One of the two diesels, originally believed to be a gasoline vehicle, was not removed until the removal of the prototypes and tests with air conditioners operating. Exhibit B.1 shows the distribution of the tests and vehicles in the data base before the removal of the prototypes and air conditioner tests, in terms of model years, standards, test temperatures, and emission control systems. An index of the vehicles, using the data base and vehicle codes from the data base, is given in exhibit B.2.

For some of the data, emissions results were reported for both individual bags and composite emissions. Where such data were given, the reported composite emissions were compared, pollutant by pollutant, with those which would be generated by the formula for composition from the bag data. In 97 cases, representing 91 tests, the reported composite was more than 0.1 grams per mile different from the calculated composite. These cases were considered invalid and not used in the fitting of temperature effect formulae. The maximum disagreements were more than 10 grams per mile. Additional apparent errors involving differences between 0.01 and 0.1 grams per mile for HC or NOx emissions were discovered but, in view of their small apparent effect, were not treated as invalidating the data involved. No other error checking or detection was possible on the data, except for random checks of individual data items against basic sources. The 46 such random checks which were conducted turned up no errors, although this limited sampling should be viewed as providing assurance only against high error rates.

EXHIBIT B.1: DISTRIBUTION OF VEHICLES AND TESTS

MYRS	STDS	LOW-TEMP. TEST/VEH	FTP-TEMP. TEST/VEH	HIGH-TEMP. TEST/VEH	AP VEH	EGR VEH	EM VEH	OC VEH	OS VEH	PCV VEH	TR VEH	TWC VEH
67	FED	6 / 3	3 / 3	3 / 3						4		
69	FED	8 / 4	4 / 4	6 / 4			4			4		
70	FED	4 / 2	2 / 2	4 / 2			2			2		
71	FED	10/ 5	5 / 5	9 / 5			5			5		
72	FED	16/ 9	14/ 9	10/ 2			2			1		
73	FED	12/12	12/12	8 / 4	3	3	1			1	1	
74	FED	40/13	37/13	12/ 7	4	4	2			1	1	
75	CAL	94/ 4	55/ 4	3 / 2	3	3		3		5		
75	FED	80/28	90/28	20/13	8	6		19		2		
76	FED	19/19	19/19	0 / 0	4			18				
77	CAL	8 / 1	6 / 1	9 / 1		1		1				
77	FED	65/38	50/38	20/ 7	8	6		35				
78	CAL	60/ 5	33/ 5	21/ 3	1	4		2	2			
78	FED	66/ 4	23/ 4	8 / 1		3		2				1
80	FED	17/ 3	13/ 3	16/ 3	1	1		1				1

EXHIBIT B.2: DATA BASE

USED IN DETERMINING PRESENCE OF TEMPERATURE EFFECTS:

DATA SET	VEHICLES
BM1	All but 44, 47, 77
BM2	All
BM3	All
CA1	1, 2, 3, 4, 5, 11
CA2	1, 2, 3, 6, 8
CH1	All
GU1	1 through 13

REMOVED PRIOR TO FITTING CORRECTION EQUATIONS:

DATA SET	VEHICLES AND TESTS
BM1	43, 46, 48, 56: all tests removed 39 test 68, 40 test 72, 41 test 76, 42 test 80, 38 test 119, 51 test 49, 52 test 54, 55 test 35, 57 test 21, 60 test 40, 61 test 59, 62 test 30, 63 test 64 removed
BM3	56 test 4, 57 test 4, 58 test 4, 59 test 4 removed
CA2	6 all tests removed
GU1	all tests of any vehicle in which the penultimate digit of the test number was one were removed